# Problem-Area Groups of Land in the Southern Great Plains

Under the direction of
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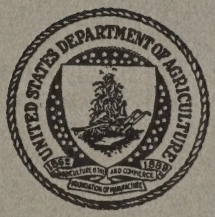


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# PROBLEM-AREA GROUPS OF LAND IN THE SOUTHERN GREAT PLAINS

Under the direction of H. H. FINNELL, *regional conservator, Soil Conservation Service*

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## PROBLEM-AREA GROUPS IN REGION 6 BASED ON PHYSICAL FACTORS

The wide variation in the type of land treatment and in the applicable methods of soil and water conservation in the southern Great Plains corresponds in general to differences in the physical conditions of the land. In order to determine the appropriate general treatment for the different conditions in Region 6 of the Soil Conservation Service, a southern Great Plains area, the Service studied the soils, physiography, erosion conditions, and climate of the region. Ten distinct combinations of these factors were recognized. All areas characterized by any one of these combinations compose a problem-area group.

There are 10 such groups, each made up of a number of noncontiguous, well-defined areas on which the physical conditions are similar. On each problem-area group and on the irrigated areas, which occupy parts of several groups, the peculiar combination of physical factors produces erosion conditions that require particular conservation methods or particular combinations of these methods.

All areas in any one problem-area group are shown on the accompanying map in a designated color. The irrigated areas are indicated by black vertical hatching on the color. Groups 2, 3, and 5 have been divided on the basis of climatic variations that affect crop adaptations and erosion. Distinctions within these three groups are marked by differences in hatching.

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The text presents a general picture of each problem-area group in terms of the physical factors that enter prominently into the different combinations that characterize the 10 problem-area groups. The descriptions of soils include comments on those characteristics that are particularly significant in distinguishing one problem-area group from another. Of primary significance are depth, texture, and productivity. The moisture relations of the soils, their infiltration and run-off rates, and their agricultural value, features of secondary importance, are described. The description of physical factors covers also the erodibility of the soils and the distinguishing physiographic features—relief, drainage, and geology.

Although irrigated areas do not compose a problem-area group they are discussed as a unit because it is necessary to use on these areas soil conservation practices that differ from those employed on the nonirrigated areas.

Soil and water conservation measures that are needed for the most efficient utilization of soil and water resources consistent with erosion control and safe land use are recommended. The recommendations are based on the experimental work of State and Federal experiment stations and the experience of the field staff of the Soil Conservation Service in Region 6. They are subject to revision in the light of additional investigations.

While the soil and water conservation measures recommended for dry-land agriculture meet the needs of soil maintenance as well as it is now possible to do, the introduction of sod-forming crops adapted to use in the various cropping systems would be a valuable addition in helping to maintain proper soil structure.

Information on physical characteristics, present land use, recommended land use, and conservation treatments is summarized in tabular form.

The areas depicted on the map are as accurate as the existing information and the scale of mapping permit. Within many boundaries are areas too small to map that actually belong to other problem-area groups. The exchange across boundaries, however, is usually reasonably equalized. Further refinement of this map must depend on an extension of detailed conservation surveys that afford a basis of treatment for each field on each farm or ranch. It is intended that the recommendations be applied to the described conditions, not strictly to the areas mapped. The description of each problem-area group represents the predominating conditions of all the areas in a group.

## PROBLEM-AREA GROUP NO. 1—ALLUVIAL SOILS

[Approximately 1,170,000 acres]

### DESCRIPTION OF PHYSICAL FACTORS

#### SOILS

**Depth and texture highly variable.**—Problem-area group No. 1 includes all the alluvial soils of the region. These soils vary widely in depth and texture. Most of them are fertile and capable of a relatively high degree of agricultural development. Minor exceptions are alkali flats. The moisture-infiltration rate varies widely. In general the rate of surface-water movement is relatively slow.

### PHYSIOGRAPHY

**Smooth relief.**—Areas in this group, for the most part, occupy bottom lands and first benches and are predominantly of smooth relief. Some of the smooth areas, however, are broken by swales and gullies. Because of this relatively smooth relief the surface drainage is slow. It is adequate, however, except on certain of the irrigated areas and in old channels and sloughs. During flood stage some of the lower lying lands are inundated. Waterlogging sometimes results from seepage, irrigation, and floods.

### ERODIBILITY

**Floods chief cause of erosion.**—Neither wind nor water erosion is serious. Damage is confined largely to deposits left by streams in flood stage and to sand deposits blown from dry beds. Some shoaling and bank cutting and sheet erosion occur during floods.

## RECOMMENDED CONSERVATION PRACTICES

### CROP MANAGEMENT

**Wide crop adaptations.**—The cropping system varies considerably over the region owing to wide variation in climate and soils. On most areas, however, it is similar to that used on the cultivated parts of the adjoining problem-area groups. Alfalfa, bromegrass, crested wheatgrass, sweetclover, and native grass are the forage and grass crops recommended where climate and moisture are favorable.

### SOIL MANAGEMENT

**Soil-management problems variable.**—The great variation in texture and depth of soils results in a large number of soil-management problems that are so complex and varied that any generalized statement would be misleading. All soil-management plans should be based on detailed surveys, which would provide an accurate picture of the problems on each soil type.

### WATER CONSERVATION

**Water-spreading structures, terraces, and pasture furrows effective.**—Level terraces on the cultivated lands and pasture furrows on the grasslands are effective for water conservation. If small terraced areas lie below escarpments it is necessary to construct diversion ditches above the terrace systems in order to protect them. When all conditions are favorable, however, run-off from the escarpments may be intercepted and spread over small areas of cultivated lands by means of retention structures. On pasture land a combination system of water-spreading dikes and contour furrows below the escarpments provides the optimum distribution of the run-off.

### FARM MANAGEMENT

**Fairly stable and diversified agricultural area.**—Farmers are in a stronger financial condition than in nonirrigated areas because the soils are relatively fertile and have more favorable moisture relations. These conditions make possible a greater diversification of

crops and the production of hay on the bottom lands. Farms include more stable livestock enterprises and comparatively well-balanced systems of dry-land farming and stock raising.

Individual units should be planned so as to effect balance in the farm organization. This planning will entail all the known applicable methods of crop and livestock management and soil treatment.

#### WILDLIFE AND WOODLAND PROGRAM

**Windbreaks and shelter strips provide protection for wildlife.**—The protection of native woody vegetation and the planting of trees and shrubs for bank protection, windbreaks, shelter strips, and farm woods will add materially to the wildlife resources. Occasional inundations and a relatively shallow water table on certain areas make natural conditions favorable to woodland growth. Farm woods for the production of fuel and posts are profitable ventures, as well as a protection to more valuable lands from damage by erosion.

### PROBLEM-AREA GROUP NO. 2—DEEP, MODERATELY HEAVY CROPLAND

[Approximately 16,620,000 acres]

#### DESCRIPTION OF PHYSICAL FACTORS

#### SOILS

**Deep, moderately heavy textured soils.**—In problem-area group No. 2 are included all the deep moderately heavy textured soils. Their textures range from loams to clays. The clay loams predominate. In general, these soils have a slow rate of infiltration and a high moisture-holding capacity. Although the rate of run-off is slow, there is a moderate amount of surface-water movement.

These soils occur within the Chernozem and dark-brown soil belts. Soil series included are Pullman, Richfield, Keith, and Abilene. Areas where these soils occur are commonly known as hard or tight lands. Wheat is generally recognized as an adapted crop on all areas in the group. Cotton in the south and corn and barley in the north also are important. Topsoils are of moderate depth and have friable crumb or granular structure. Under virgin conditions the topsoils contain a relatively high percentage of organic matter. The subsoils, which are deep, range from a granular structure in the upper part to an angular cloddy nature in the lower part. Both the topsoil and the upper subsoil are noncalcareous. The depth to lime ranges from 16 to 30 inches. The average depth is about 24 inches. The zone of dense carbonate accumulation occurs at a depth of 2½ to 5 feet, the average depth being approximately 4 feet.

#### PHYSIOGRAPHY

**Smooth relief.**—The areas that compose this group occur principally in rather large tracts within the High Plains. There are some small areas in the Rolling Plains. Although the parent materials of the soils include Tertiary outwash, loess deposits, and residual clays and shales, development of these soils has been very similar owing to the gentle slopes on which they occur. Most of the slopes are less than 3 percent. Drainage is very slow, and, with the exception of the

loessial and Rolling Plains areas, external drainage systems are poorly developed. Most of the run-off water collects in numerous intermittent shallow lakes or playas.

### ERODIBILITY

**Erodes rapidly by wind when not protected.**—Water erosion is slow and is a minor problem, but wind erosion progresses rapidly and becomes serious when crop residues or plant cover are inadequate.

### RECOMMENDED CONSERVATION PRACTICES

#### CROP MANAGEMENT

**Diversified flexible cropping system.**—A more dependable succession of crops is essential to the highest degree of safety from wind erosion. The natural variability in amount and distribution of rainfall necessitates flexibility in cropping plans in order to utilize efficiently the current seasonal resources for producing plant cover.

A flexible cropping system, along with those physical advantages that permit control of wind erosion, is capable of creating a more stable economic condition. Where wheat is the major crop it should be grown during years in which soil moisture and crop residues are adequate. Erosion-resistant crops of sorghums should be substituted when soil moisture and crop residues are unfavorable for wheat. Summer fallowing is a profitable practice when crop residues are adequate but soil moisture is deficient. Erosion-permitting crops, such as corn and cotton, should be grown between strips of erosion-resistant crops, such as the sorghums.

Owing to the wide climatic range, crop adaptations vary considerably. Wheat production is the chief enterprise. The general efficiency of soil and water utilization not only has been very low, but maintenance of adequate cover or crop residues for protection against wind erosion has not been a common practice.

Feed crops and forages that are incidental to the production of cash crops may be more efficiently utilized through consumption on the farm by a small permanent livestock enterprise or by transient feeder livestock than through direct marketing.

The three types of areas into which this problem-area group has been divided are based on crop adaptations that result largely from differences in soil temperatures and length of the growing season.

**Problem-area group No. 2a: Wheat, corn, barley (approximately 2,110,000 acres).**—Wheat ranks first among the crops. Corn and barley occupy important places in the farming system. Early maturing varieties of sorghums may replace corn to some extent. Barley is produced primarily because it fits into a cropping system with corn production. It is also used as a catch crop in case of wheat failure. A goal of balanced production through diversification of wheat, feed crops, and summer-fallow practices, as far as consistent with seasonal conditions, is recommended. Early maturing sorghums should be grown and may be used in a strip-crop pattern as an erosion-resistant crop to protect erosion-permitting crops, such as corn, and fallow.

**Problem-area group No. 2b: Wheat, sorghums (approximately 10,431,000 acres).**—Wheat is the most important crop, and sorghums are of secondary importance. In the northern part of this problem-area group summer fallow is recognized as a more general practice,

whereas in the southern part summer fallow is considered of less importance in the cropping system and is used only in case of moisture deficiency and where adequate residues are present to protect the clean-fallowed land from wind erosion.

The cropping practices should include a flexible cropping plan that takes into consideration the soil moisture, fertility, and physical conditions of the field at planting time. In the interest of maintaining a cover of vegetation favorable opportunities for production should not be ignored.

Problem-area group No. 2c: Wheat, cotton, sorghums (approximately 4,079,000 acres).—Small grains and sorghums occupy important places in the farming system. Freedom of these areas from insect pests and the fact that cotton has the ability to take advantage of favorable growth conditions are bases for extensive cotton production. Strip cropping of wheat or cotton with sorghums should be used to control wind erosion. Residues from sorghums and small grains should be conserved for erosion control.

Wheat may sometimes be seeded in the fall on the cotton lands primarily as a cover crop and as a means of furnishing some winter grazing for livestock.

SOIL MANAGEMENT

Timely tillage effective.—It is desirable that implements used in the preparation of land for wheat be designed to leave crop residues lightly mixed in the surface soil and to provide a cloddy and ridged or furrowed surface. Such operations should be carried out with proper regard to soil-moisture conditions. In the planning of subsequent cultivation for weed control the same objectives should be kept in mind. The same considerations affect early spring preparation of land not in wheat but intended for summer fallowing or summer crops. Timely tillage practices designed to further the prevention of wind erosion and carried out as a part of the regular operations in crop production and soil-moisture conservation should not be confused with emergency tillage resorted to after neglects and abuses have resulted in the development of serious erosion conditions. Emergency tillage is necessary as an extra or unproductive operation.

Emergency tillage sometimes needed but of temporary value.—Owing to the heavy texture and cloddy soil structure, emergency tillage methods that clod or roughen the surface are of value in temporarily controlling or checking wind erosion. Since weathering tends to break down the cloddy structure the effectiveness of such control measures is temporary.

WATER CONSERVATION

Terracing and contour farming increase crop production.—The amount of run-off water that can be retained on the land for crop utilization through a system of contour tillage supported by level terraces is sufficient to increase greatly the dependability of crop production and thereby eliminate many wind-erosion hazards caused by crop failure and the resulting shortage of residue. Because large power machinery is used the wheatland terrace has been developed.

The wheatland terrace has a minimum base width of 40 feet for each foot of terrace height. Even on slopes as flat as those on these areas, it has been found that more effective distribution of run-off water is obtained by tilling and planting parallel to the terraces than by per-

forming these operations irrespective of the contour and depending upon terraces alone to distribute the water. Terraces are therefore considered more as a support to contour tillage and a part of a water-conservation system than as a definite water-conservation system in themselves.

**Contour furrowing profitable.**—Contour furrows on a spacing of 42 to 84 inches have been found to be the most effective water-conservation structures on the areas of native grassland. This system of furrows has given the highest yield, owing to the availability of conserved moisture for plant utilization.

### PASTURE MANAGEMENT

**Overgrazing should be prevented.**—Where livestock is a part of the farm enterprise particular attention should be given to the production of supplementary pasture or feed in order to prevent overgrazing of the small permanent pastures. Adequate feed reserves should be maintained to prevent overgrazing of crop residues and the grazing of winter wheat at inopportune periods.

### LAND RETIREMENT

**Land retirement a minor problem.**—Only a very small percentage of the land in this problem-area group has been damaged to an extent necessitating retirement to grass in order to control erosion successfully. The major needs in conserving the soil are met by improved water-conservation and crop-management practices.

### FARM MANAGEMENT

**Maintenance of plant cover necessary.**—On these areas of wheat production the need for farming methods that produce an adequate cover of vegetation when the land is not in wheat makes necessary the consideration of a small permanent or transient feeder livestock enterprise. This in turn requires adequate feed reserves and the maximum utilization for grazing of all lands of other problem-area groups that lie within group No. 2. When an adequate cover cannot be maintained emergency tillage can be used. A better balance between farm enterprises is needed.

**Flexible cropping system permits a more stable economic condition.**—Introducing an element of flexibility sufficient to meet variable seasonal conditions will bring about an increase in the production of feed crops. Individual farm organizations must then be planned so as to utilize this feed production. This diversification required to meet the physical necessities of wind-erosion control will bring about a more stable economic condition. Since a suitable balance between livestock and the available feed supply must be maintained, it is recommended that an adequate feed reserve be set up by means of trench silos or other storage facilities. Continuous feed supply may be further assured by the practice of summer fallowing for feed crops.

**Problem-area group No. 2a: Wheat, corn, barley.**—It is recommended that more sorghums be seeded to replace acreages of corn and to a small extent wheat in order to balance the farm organization and improve the effectiveness of the plant cover. This change in farm organization may entail an increase in the size of the livestock enterprise in order to utilize the increased feed production.

**Problem-area group No. 2b: Wheat, sorghums.**—The production of sorghums is essential in the recommended system of farming, which introduces the livestock enterprise. The system recommended also requires an additional investment to provide for row-crop farming machinery, feed-storage facilities, and the purchase of livestock.

**Problem-area group No. 2c: Wheat, cotton, sorghums.**—It is recommended that more sorghums be seeded to replace acreages of wheat or cotton to balance the farm organization and improve the effectiveness of plant cover. This change in farm organization would entail an increase in the size of the livestock enterprise in order to utilize the increased feed production.

#### WILDLIFE AND WOODLAND PROGRAM

**Windbreaks and shelter strips advisable.**—Windbreaks and shelter strips to protect field borders and farmsteads from erosion are recommended. If wind erosion is controlled on adjacent fields moisture conditions can be made favorable by the use of diversion and impounding structures. At least 30 inches of water annually, including rainfall, is required for successful plantings. The following are of major importance to wildlife: Sufficient crop residues; strip cropping; sorghum border plantings; and shelter strips and windbreaks.

### PROBLEM-AREA GROUP NO. 3—DEEP, MODERATELY SANDY DIVERSIFIED CROPLAND

[Approximately 3,720,000 acres]

#### DESCRIPTION OF PHYSICAL FACTORS

#### SOILS

**Deep, moderately sandy, and highly productive.**—Problem-area group No. 3 includes the deep, moderately sandy, and highly productive soils of the region. These soils have a moderately rapid rate of infiltration and a high moisture-holding capacity. The most common texture is a fine sandy loam. Productive sandy loams and loamy fine sands with sandy clay loam or sandy clay subsoils also occur. The run-off is slow, but there is normally a moderate surface-water movement during heavy rains.

These soils lie almost entirely within the dark-brown soil belt. A small part of this problem-area group is within the Chernozem belt. The soil series represented include Pratt, Amarillo, Miles, and Springer. These soils are commonly known as mixed lands, and although they are used principally for the production of row crops, wheat is grown successfully. Small areas that occur in association with heavy-textured soils are frequently used for wheat production. The surface soils are predominantly fine sandy loam. The structure of the surface soil is crumb to single grain and has a very friable consistency. The subsoils, which range from sandy clay loam to sandy clay, break into large prismatic columns when dry. With pressure these columns break down into small, irregular clods. The topsoil and upper subsoil are noncalcareous. Depth to lime ranges from 16 to 30 inches and averages about 24 inches. The zone of dense carbonate accumulation occurs below 30 inches. The average depth to this zone is about 40 inches.

PHYSIOGRAPHY

**Smooth relief.**—The principal areas in this group are scattered throughout the High Plains. There are also a few relatively small areas in the Rolling Plains. These areas are on Quaternary outwash in the High Plains and on the Permian "Red Beds" in the Rolling Plains. On both the High Plains and the Rolling Plains the soils in some places have been modified by wind action. Relatively smooth relief prevails, there being an average slope of 2 percent or less. Slopes in excess of 4 percent are rare. Drainage on the High Plains is principally into shallow lakes. On the Rolling Plains the drainage is into streams.

ERODIBILITY

**Erodes easily by wind when not adequately protected.**—On the High Plains water erosion is a minor problem, but erosion by wind is serious when crop residues are inadequate. On the Rolling Plains water erosion is moderate, but wind erosion is serious when crop residues are inadequate.

## RECOMMENDED CONSERVATION PRACTICES

CROP MANAGEMENT

**Strip cropping important.**—Owing to the wide range in the length of frost-free periods there are many adapted crops. Corn, sorghums, cotton, and wheat are the principal crops. Corn and cotton are properly classified as erosion-permitting crops, and wherever they are grown they should be strip-cropped with adapted varieties of sorghums. In any case, maintenance of adequate crop residues is necessary to control erosion.

The cropping practices are more diversified than in any other problem-area group. This is especially true in the southeastern and southern parts of the region. There are many adapted crops that may be rotated from year to year. A strip-crop rotation of cotton, sorghums, and small grain should be used in order to distribute the cover effectively. This practice will give consideration to feed crops and soil-conserving crops. Conservation of residues is necessary to reduce soil blowing. Small livestock units are needed to utilize the feed crops.

This problem-area group is divided into four types of areas.

**Problem-area group No. 3a: Corn (approximately 395,500 acres).**—Corn ranks first among the crops. Small grains, such as wheat and barley, are of secondary importance. Barley fits into the crop rotations with corn and is used also as a catch crop after wheat failure. Early maturing sorghum crops should be used as erosion-resistant crops in a strip-crop pattern alternated with corn, in order to control wind and water erosion. Rye may be planted after corn as a cover crop and for winter grazing.

**Problem-area group No. 3b: Feed crops, some wheat (approximately 918,800 acres).**—These areas are scattered over the central part of Region 6. They are adapted to sorghum crops, corn, small grains, and beans. The erosion-control practices consist of growing the erosion-resistant crops alternated with erosion-permitting crops in a strip-crop pattern on the contour. The conservation of residues

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through the proper use of tillage practices and controlled grazing is needed to reduce susceptibility to blowing.

Problem-area group No. 3c: Cotton and sorghums, some wheat (approximately 626,500 acres).—A soil-erosion-control and moisture-conservation program where cotton predominates must be based on the system of strip cropping the cotton with an erosion-resistant crop such as the sorghums. Either of two patterns of strip cropping may be followed. (1) The fields should be terraced, and tillage operations should follow the terrace. The first year the terraces should be planted to sorghums and the terrace intervals to cotton or wheat. (2) The strip lines should be run on the contour and at least one-third of the area planted to sorghums along the contour lines, the remainder of the area in the intervals being planted to cotton or wheat. Turn rows and point rows should be planted to Sudan grass, sorghums, or permanent grass to prevent soil blowing and washing.

Rye may be grown to some extent as a winter cover crop and as a soil-building crop.

Problem-area group No. 3d: Cotton and sorghums (approximately 1,779,200 acres).—Crop production is more dependable than in other problem-area groups, since the rainfall is slightly higher and fluctuates less from year to year. Systematic cropping rotations can be followed with more certainty. Legumes and green-manure crops are desirable for maintaining the soil fertility. Erosion control in areas where cotton predominates is based on a system of strip cropping with an erosion-resistant crop such as the sorghums. Several patterns of strip cropping are recommended. (1) The fields should be terraced, and tillage operations should follow the terraces, which are planted to sorghums the first year. (2) Strip lines should be run on the contour and at least one-third of the area planted to sorghums. Turn rows and field roads should be planted to Sudan grass, sorghums, or permanent grass to prevent soil blowing and washing. Small grains, such as oats and wheat, may be grown in the fall after a cotton crop and used for supplemental grazing as well as for cover crops. In the early spring if the wheat shows promise of making a profitable crop it is left to mature for harvest; otherwise, the wheat is plowed down and the field bedded for a cotton or sorghum crop. Austrian Winter peas may be grown also as a legume crop and used to build the soil.

### SOIL MANAGEMENT

Timely tillage effective.—It is desirable that implements used in the preparation of land for wheat be designed to leave crop residues lightly mixed in the surface soil and to provide a cloddy and ridged or furrowed surface. These operations should be carried out with regard for soil-moisture conditions. Planning of subsequent cultivation for weed control should keep the same objectives in mind. The same considerations apply to early spring preparation of land not in wheat but intended for summer fallowing or summer crops. Listing or chiseling between the rows of stubble or crop residues previous to the spring blow season is applicable to the entire problem-area group. Timely tillage practices designed to further the prevention of wind erosion and carried out as a part of the regular operations in crop production and soil-moisture conservation should

not be confused with emergency tillage resorted to after neglects and abuses have resulted in the development of serious erosion. Emergency tillage is as an extra or unproductive operation.

**Emergency tillage most effective when soil is wet.**—Emergency tillage operations are of little value in checking wind erosion unless they are performed when the ground is wet or the tillage is deep enough to bring clods to the surface from the lower subsoil. At best, emergency tillage is very temporary, and maintenance of adequate crop residues together with timely tillage is of greater importance in controlling wind erosion.

### WATER CONSERVATION

**Contour tillage and terracing conserve moisture.**—Contour tillage, supported in most instances by level terraces, is needed to prevent loss of water by run-off and to provide optimum moisture distribution.

The row-crop terrace used on these areas has a base width of 30 to 35 feet for each foot of effective height. The average height of these terraces is approximately 18 inches. This terrace was developed to meet the needs of power-farming equipment up to four rows in width. While this equipment is large, it does not require so flat and broad a cross section as the large wheat equipment. The slopes generally require higher terraces than those in problem-area group No. 2.

**Responds readily to contour furrowing.**—Land in native grass responds readily to contour furrowing. As in problem-area group No. 2, vegetation returns most rapidly on the small furrows. However, owing to the moderately sandy nature of the soil, contour ridges more readily revegetate and are more adaptable in combination with furrows than in problem-area group No. 2.

### PASTURE MANAGEMENT

**Permanent livestock enterprises needed.**—Permanent livestock enterprises are needed to utilize the feed crops produced. Except where adjacent grazing lands of other problem-area groups are available, it is necessary to stress the importance of growing supplementary feeds to prevent the overgrazing of small pastures. The production and storing of reserve feed supplies are recommended.

### LAND RETIREMENT

**Very little land should be retired.**—Only a small amount of land has been more than moderately eroded. The cultivated land, therefore, can be utilized for the production of crops. Very little, if any, should be retired to permanent vegetation.

### FARM MANAGEMENT

**Farm income comparatively high.**—The present farm income is comparatively high and fluctuates less from year to year than in the other dry-farming areas of the region. The livestock enterprise is important, although the principal income is derived from crops.

A cropping system that will provide for maintenance of plant cover and soil fertility and maintain or increase the farm income is essential in the management of the farm unit.

**Windbreaks and shelter strips afford protection.**—Windbreaks and shelter strips to protect fields and farmsteads from wind erosion are advisable if erosion on adjacent fields can be controlled and if sufficient surface run-off can be diverted and impounded on the site to raise the annual water supply to the equivalent of at least 30 inches or more of rainfall. The beneficial effect of field windbreaks and shelter strips on crops produced is indicated by observations, although not tested by experiments. Wasteland and odd corners not utilized for crop or pasture should be planted to native trees and shrubs for wildlife. The following are of major importance to wildlife: Crop residues, strip cropping, border planting, shelter strips and windbreaks, and pasture improvement.

## PROBLEM-AREA GROUP NO. 4—GRAZING AND FEED-CROP AREA; SOILS OF MEDIUM DEPTH

[Approximately 11,000,000 acres]

### DESCRIPTION OF PHYSICAL FACTORS

#### SOILS

**Medium depth.**—Most of the soils in problem-area group No. 4 are clay loams that have a slow infiltration rate and a high moisture-holding capacity. Run-off may be slow to moderately rapid. There is considerable surface-water movement during heavy rains.

These soils occur principally within the Brown soil belt. Inasmuch as the detailed surveys that have been made in this area are very recent, soil series have not been definitely correlated. The topsoils are usually of moderate depth and very friable. They may be slightly calcareous very close to the surface; however, the depth to free carbonates ranges from about 8 to 14 inches. The structure of the subsoil consists of irregularly angular clods, which may be soft or moderaately hard.

#### PHYSIOGRAPHY

**Smooth to rolling relief.**—The areas in this group are in widely separated parts of the region, but are located principally on the High Plains, the larger areas being in the north-central part of the region. The soils have been developed from Tertiary outwash and loess. In many places the outwash material shows evidence of being reworked by wind. Relief is smooth to undulating, with the exception of some rolling areas, especially where the soils are developed on loess. On the smooth areas drainage is principally into shallow lakes; however, over most of the areas stream drainage has developed.

#### ERODIBILITY

**Erodes easily by wind when inadequately protected by growing vegetation or crop residues.**—Water erosion is moderate on certain areas in this group. Wind erosion becomes serious when crop residues, such as sorghum stubble and trash from other crops, are inadequate. Much of the cultivated land has been severely damaged by wind erosion.

## RECOMMENDED CONSERVATION PRACTICES

### CROP MANAGEMENT

**Need for change in crops, strip cropping, and maintenance of residues.**—This problem-area group lies mainly to the west of problem-area group No. 2. The shallower soils and less favorable climatic conditions have been responsible for numerous crop failures where an attempt has been made to grow wheat continuously. Large blocks of this land have been abandoned and lie idle, with no protective cover of vegetation. Because attempts at continuous wheat farming have resulted in severe erosion the acreage utilized for the production of wheat should be reduced to a minimum. Very severely damaged areas and the more sloping cultivated land should be retired to permanent vegetation. The remainder should be utilized largely for the production of feed crops, special care being taken to grow erosion-resistant varieties either in solid plantings or in strips and to maintain adequate stubble and other residues for erosion control. To insure the production of some feed for livestock each year, part of the feed-crop acreage should be planted on summer-fallowed land. Both cash- and feed-crop production could be made dependable by the use of protected summer fallow.

### LAND RETIREMENT

**Permanent vegetation should be restored.**—Stabilization of the retired lands by contour listing and chiseling, by allowing weed growth to become established, and perhaps by a natural invasion of the primary stages of perennials may be a solution of a part of the problem of revegetation. As soon as the seasonal conditions and economic means permit, grass cover may be seeded on these lands.

### SOIL MANAGEMENT

**Timely tillage effective.**—It is desirable that implements used in the preparation of land for the seeding of crops be designed to leave crop residues lightly mixed in the surface soil and to provide a cloddy and ridged or furrowed surface. This operation should be carried out with regard for soil-moisture conditions. In planning of subsequent cultivation for weed control the same objectives should be kept in mind. The same considerations affect early spring preparation of land intended for summer fallowing or summer crops. Timely tillage practices designed to further the prevention of wind erosion and carried out as a part of the regular operations for crop production and soil-moisture conservation should not be confused with emergency tillage resorted to after neglects and abuses have resulted in the development of serious erosion conditions. Emergency tillage is necessary as an extra or unproductive operation.

**Emergency tillage necessary but of temporary value.**—The use of tillage methods that clod or roughen the surface is valuable in temporarily checking wind erosion. Owing to the fact that the surface soil is very friable and that subsoil clods soon weather into a friable consistency such methods are very temporary, and wind erosion can be controlled only by a good cover of growing crops or crop residues. Since it is difficult to maintain a good cover of cultivated crops on these soils after they have been severely eroded, all badly eroded areas should be retired to permanent grass cover as rapidly as possible.

WATER CONSERVATION

**Terraces and contour treatment conserve moisture.**—Contour tillage supported by terraces is needed to prevent run-off and to secure the best distribution of moisture on cultivated lands. Owing to the large variety of adaptable crops either the wheatland or row-crop terrace may be used, depending on the agronomic program for any individual farm.

Owing to the relief, both wheatland and row-crop terraces are on the average larger than in problem-area groups Nos. 2 and 3. Native grassland responds readily to small contour furrows. Because of the comparatively low rainfall and the texture of the soil, contour ridges do not revegetate rapidly. However, on some of the steeper slopes a combination of contour ridges and contour furrows is proving effective as a water-conservation system. Many small earth dams are built to provide stock water. These are located in such a manner as to provide the most effective distribution of grazing.

RANGE MANAGEMENT

**Unit reorganization with controlled grazing necessary.**—Limited grazing of ranges for several years, particularly rotated and deferred grazing, is necessary in order to allow natural revegetation of the ranges. Stock water is needed. Supplementary feed crops should be produced and feed reserves established to carry over livestock during expected drought years.

FARM AND RANCH MANAGEMENT

**Retirement an important factor.**—The size and type of unit are the primary factors for consideration. Severely eroded cultivated land should be retired to grass.

**Low farm income result of improper land use.**—The income per farm unit is lower in this problem-area group than elsewhere in the region. This condition has been aggravated by improper land use.

A speculative type of agriculture, along with a high degree of tenancy, results in much abandonment during drought periods.

During the expansion period wheat production partly displaced the original ranch and livestock economy. The result was financial failure, in many cases, in addition to accelerated damage by wind erosion to cultivated lands and damage to neighboring pasture lands already depleted of cover.

**Unit reorganization with livestock economy essential.**—Agriculture in this area should be based on a livestock economy. Approximately 50 percent of the present cultivated acreage should be retired to grass, and the remainder should be devoted to production of crops—the greater part to the production of feed crops and temporary pasture. The size of units in the agricultural pattern must be revised eventually in order to set up operating units that are economically profitable in a livestock economy.

Farm or ranch planning is a problem of setting up an operating unit of a size and type sufficient to insure the operator a reasonable living. The problems of planning and organizing such units are many and varied.

**Windbreaks useful for the protection of livestock.**—The provision of windbreaks for the protection of livestock would encourage a shift from cash crops to livestock. Much livestock is lost during blizzards because of the practice of winter grazing. Windbreaks developed in the southeast corner of a pasture offer a shelter for livestock drifting with a blizzard. Such windbreaks, if properly designed, are more permanent and more effective than board shelters. Structures to divert and impound run-off water must be made in order to supply the water necessary for the plantings.

Care must be exercised in the planting of windbreaks and shelter strips to avoid the continued cultivation of soil that should be retired to grass or other permanent vegetation. On the other hand, fields that may properly be continued in cultivation should be protected by windbreaks and shelter strips if sufficient moisture can be made available. Gullies that cannot be effectively controlled as a part of the major land use should be fenced and planted to trees, shrubs, and vines. Dams built to provide stock water may be planted with shrubs where such treatment is more economical than riprapping or sodding. The life of stock ponds can be materially lengthened by block plantings of mat-forming shrubs and vines of value for wildlife. Retirement of cultivated land to grassland, strip cropping, and the leaving of crop residues are good wildlife-management practices.

## PROBLEM AREA GROUP NO. 5—DEEP SANDY ROW-CROP LAND

[Approximately 12,230,000 acres]

### DESCRIPTION OF PHYSICAL FACTORS

#### SOILS

**Deep, sandy, moderately productive.**—Problem-area group No. 5 includes the deep, moderately productive, sandy soils of the region. The principal textural grades are sandy loams and loamy fine sands. Loamy sands with sufficient clay in the subsoil for adequate moisture storage also are included. The moisture-infiltration rate is rapid, and these soils have a moderate moisture-holding capacity. Very little run-off occurs except on the more steeply sloping areas and where heavy subsoils are near the surface.

While these soils occur principally in the dark-brown soil belt, they also occur to a limited extent in the Brown soil belt. The soil series included are Amarillo, Pratt, and Springer. These are commonly known as the sandy row-crop lands and consist of deep sandy loam to loamy sand topsoils usually underlain by sandy clay loam subsoils. The subsoil in some places is of a sandy loam texture. The topsoil and upper subsoil are noncalcareous. The surface soil has a single-grain structure; the subsoil is characterized by its tendency to break into large prismatic columns when dry. The depth to lime ranges from 1½ to 5 feet. The average depth is approximately 2 feet. These soils have a wide crop adaptation, but they are best suited to the production of crops that make their growth during the frost-free season because they are not capable of storing enough soil moisture to support plants through the normally dry winter months.

PHYSIOGRAPHY

**Undulating to gently rolling relief.**—Areas of this group are scattered throughout the region. On the High Plains the soils are principally on Tertiary outwash, which material in many places has been considerably modified by wind action. On the Rolling Plains the soils are on both wind- and water-laid Quaternary deposits and are also developed on "Red Bed" sandstones. Undulating to gently rolling relief prevails over most of the areas. The usual slope range for the region is 2 to 5 percent. Slopes are steeper on the Rolling Plains than on the High Plains. In general, drainage is into streams.

ERODIBILITY

**Erodes easily by wind.**—Water erosion over most of the areas is slow. Moderate sheet erosion and some gullying are in evidence on the more rolling areas. Wind erosion is rapid when plant cover or crop residues are inadequate.

## RECOMMENDED CONSERVATION PRACTICES

CROP MANAGEMENT

**Strip cropping important.**—Because of its wide climatic variations this problem-area group is suited to the production of a large variety of crops. Corn, sorghums, and cotton are the principal crops except in the western areas, where beans are sometimes grown. Inasmuch as corn, cotton, and beans leave very little protective residue, strip-cropping with more erosion-resistant crops, such as the sorghums, is necessary for wind-erosion control. Careful preservation of crop stubbles and other residues is necessary to control wind erosion.

A combination of reclamation and revegetation of the more damaged areas with improved crop management that provides a continuous plant cover is necessary to control erosion. This requires the use of erosion-resistant crops such as sorghums, both grain and forage, either in solid plantings or in a strip-crop pattern. Adequate residues should be retained each cropping season, and timely tillage measures should be used along with the stubbles and residues to protect the land from soil drifting.

Sorghum border plantings should be used on all cultivated areas that adjoin areas where erosion hazards are present. Adequate stubbles should be left and no field grazing permitted.

Some of these once productive sandier soils have been damaged to such an extent that it will be necessary to retire these lands to permanent vegetation to prevent further severe damage by erosion. Revegetation of such areas will provide more pasture and will aid in balancing the farm unit.

**Problem-area group No. 5a: Corn, beans, and feed crops (approximately 2,129,500 acres).**—Corn and beans have been the principal crops, and the very severe soil losses that have occurred have necessitated the retirement of large areas to grass. On areas that have been only slightly to moderately eroded stabilization may be accomplished by growing erosion-resistant varieties of cultivated crops, such as the early maturing varieties of sorghums.

**Problem-area group No. 5b: Feed-crop area (approximately 5,815,500 acres).**—The sorghums are adapted. The growing of corn and wheat on these soils in the past has contributed to damage by

wind erosion. Since many of these soils are badly eroded they should be stabilized by growing erosion-resistant sorghum crops, which return a large amount of plant residues to the soil. After stabilization has been reached, erosion control on those lands that remain in cultivation may be accomplished by alternating strips of corn with other erosion-permitting crops with sorghums.

Problem-area group No. 5c: Cotton and sorghums (approximately 3,075,000 acres).—Cotton is the principal crop and should be systematically grown in strips with sorghums in a strip-crop pattern on the contour. The maximum width of strips of cotton should be from 15 to 20 rows. These strips should be alternated with strips of sorghums of an equal or a greater number of rows. Border plantings of close-drilled Sudan grass or other sorghum varieties around field boundaries and turn rows and also in the point-row area to reduce soil blowing is recommended. Small grains may be planted as cover crops after the cotton is harvested and used for supplemental grazing through the winter months.

Problem-area group No. 5d:—Cotton and sorghums (approximately 1,210,000 acres).—Moderately damaged by water erosion. The cultivated part is devoted principally to cotton and sorghum production. Some corn is grown as a feed crop. Systematic rotations and use of soil-building crops may be practiced. The proper strip-cropping arrangement of erosion-resistant and erosion-permitting crops in rotation provides a safeguard against wind and water erosion. Conservation of crop residues should be practiced in order to control wind and water erosion.

### SOIL MANAGEMENT

Timely tillage effective.—It is desirable that implements used in the preparation of land for summer crops be designed to leave crop residues lightly mixed in the surface soil and to provide a trashy and ridged or furrowed surface. These operations should be carried out with regard for soil-moisture conditions. In planning of subsequent cultivation for weed control the same objectives should be kept in mind. Timely tillage practices, such as tillage between the stubble rows of sorghums previous to the severe blowing season, designed to further the prevention of wind erosion and carried out as a part of the regular operations for crop production and soil-moisture conservation should not be confused with emergency tillage resorted to after neglects and abuses have resulted in the development of serious erosion conditions. Such emergency tillage is necessary as an extra or unproductive operation.

Emergency tillage effective only when soil is wet.—These soils have deep, loose, friable topsoils, and it is difficult to get tillage implements deep enough to bring clods to the surface in dry soil. By carrying on tillage operations when the soil is wet, however, it is possible to produce a clodded condition that is of temporary assistance in controlling wind erosion. Owing to the relative ineffectiveness of emergency-tillage methods, special care is necessary in the maintenance of crop stubbles and in timely tillage as a means of wind-erosion control.

### WATER CONSERVATION

Contour treatment conserves moisture.—The water relations of these lighter types of productive soils are highly favorable to an effi-

cient utilization of rainfall. An uneven relief renders impractical many of the conservation practices employed on the heavier soils. However, as a moderate amount of run-off occurs during heavy rains, available moisture for plant utilization on these soils can be increased by contour tillage. On the sharply undulating areas, where farming on the contour is impractical, farming across the general slope is sufficient.

While terracing as a general practice is not recommended, localized areas that have heavy subsoils or moderate slopes have responded to terracing. Owing to the light texture of the soils, terraces should be either row-crop terraces planted to a fibrous-rooted crop, or narrow-base terraces seeded to permanent vegetation, such as grass.

Those areas in native grass have responded more satisfactorily to contour ridges than similar areas in any of the other problem-area groups. Contour ridges seemingly produce their best results on the flatter slopes (up to 1 and 1½ percent) owing to the fact that run-off water impounded behind these ridges is more readily absorbed by the soil and the vegetation is not covered by it sufficiently long for damage. These ridges have been found to revegetate more rapidly in this than in other problem-area groups. The larger contour furrows, except where blow hazards are adjacent, are effective on all slopes of this area.

### PASTURE MANAGEMENT

**Proper pasture management necessary.**—Particular attention should be given to proper management of range lands. On ranges that are continually overgrazed the climax perennial grasses are replaced by less desirable perennial grasses, unpalatable annual grasses and weeds, and shrubs. On areas where there is an overconcentration of livestock as a result of improper salting methods and inadequate water supplies the trampling will severely damage the ranges. Proper range management will prevent such damages. Restricted grazing is essential to facilitate revegetation of retired lands.

### FARM MANAGEMENT

**Incomes relatively stable.**—The organization of farms is generally such that there are relatively stable annual incomes. A diversity of cash crops and feed crops for livestock enterprises has resulted in less abandonment of farms and farm land than in hard-land areas of similar climatic conditions. A smaller proportion of crop failures is prevalent on these deep sandy soils. Farming as a type may be described as cash-crop-sorghums-livestock farming.

**Adequate feed reserves essential.**—Maintenance of adequate feed reserves in conjunction with the production of cash crops is essential for the livestock enterprise. Market conditions for the cash crops, such as corn, beans, broomcorn, cotton, and sorghum grain, make considerable variation from year to year in the farm income.

**Balanced farm organization essential.**—Although only a little over 10 percent of the cultivated land must be returned to permanent vegetation in order to control wind erosion effectively, considerable reorganization of farm units is needed for a better-balanced type of

farming. To sustain a livestock enterprise of sufficient income for a farm family more pasture, or provision for supplementary feed, is needed on many farms. The farm units should be so planned as to provide a proper balance between cash crops, feed crops, and livestock. Emphasis should be placed on increasing the production of livestock feed that will provide the maximum degree of resistance to soil erosion.

#### WILDLIFE AND WOODLAND PROGRAM

**Wildlife and woodland possibilities somewhat limited.**—Because of the small amount of run-off, woodland and wildlife plantings must utilize species adapted to the low precipitation. It will also be necessary to expect a shorter rotation with these species than would be expected where run-off water can be added to the natural precipitation. Gullies formed by water erosion should be planted for wildlife or woodland areas if they have progressed to such an extent that they cannot be utilized for crops or grazing. The beneficial effect of field windbreaks and shelter strips is apparent.

### PROBLEM-AREA GROUP NO. 6—SHALLOW GRAZING LAND

[Approximately 23,000,000 acres]

#### DESCRIPTION OF PHYSICAL FACTORS

#### SOILS

**Shallow.**—All the shallow and very shallow soils except the rough, broken, and stony lands and the mountainous areas are included in problem-area group No. 6. The texture of these soils varies from very heavy to sandy, but the predominant textures are clay loams and loams. The rate of run-off varies considerably, owing to variation in relief and texture. However, during heavy rains considerable surface-water movement occurs on all except the sandy textured soils, and this area is recognized as a flood source.

While these soils are developed as zonal types only within the Brown and the Gray Desert soil belts, they occur also on more steeply sloping areas within the dark-brown and Chernozem belts. All of these soils have very shallow, friable topsoils. They are usually calcareous at the surface. The principal soil series are Potter, Vernon, Prowers, Penrose, and Minnequa. Owing to their shallow depth and the broken relief on which they frequently occur, they are generally recognized as being best suited for grazing.

#### PHYSIOGRAPHY

**Smooth to rolling relief.**—Areas of this group are scattered throughout the entire region. They vary considerably in surface relief. On the greater part of this problem-area group the relief is rolling, but there are some shallow and very shallow soils on smooth relief. Most of this problem-area group has a well-developed system of stream drainage.

#### ERODIBILITY

**Erodes easily by both wind and water.**—Both wind and water erosion are serious when the soil does not have an adequate cover of

vegetation. This is especially true on land that has been placed in cultivation and on the more steeply sloping areas.

Erosion conditions.—Badly denuded range lands have been moderately to severely damaged by both wind and water.

### RECOMMENDED CONSERVATION PRACTICES

#### LAND RETIREMENT

Retirement to permanent vegetation imperative.—Cultivated lands should be retired to permanent vegetation, with the exception of those small isolated areas within problem-area groups more suitable to cultivation.

Much of this problem-area group was cultivated during the agricultural expansion, but during the past 5 years most of these lands have been abandoned, owing to the shallow nature and low productivity of the soils. These lands should have remained in native grass, and now their eroded condition makes imperative their retirement to permanent vegetation.

#### WATER CONSERVATION

Contour treatment effective.—Contour treatment of range lands will aid greatly in controlling run-off and will provide better moisture distribution. Full utilization of moisture by conservation practices will increase greatly the amount of plant residues produced and is therefore an important aid in the control of wind and water erosion. On steeper slopes combinations of contour furrows and contour ridges are proving effective not only as moisture-conservation systems but also as a means of flood control. Much of the land in this problem-area group is a source of run-off water, which often must be collected by diversion ditches and released on slopes where it can be effectively controlled and utilized. Gully control is a serious problem, and is best accomplished through the use of these diversion structures combined with furrowing systems.

In some localities temporary check dams have proved beneficial for obtaining soil and moisture for plantings that may be used to promote wildlife propagation. The areas in this group offer one of the best opportunities for the development of springs, which are proving very satisfactory as a means of obtaining stock water. Earth dams are used to a large extent in wildlife propagation and for diversion purposes, flood control, and stock water. Many of these dams serve two or more of these purposes.

#### SOIL MANAGEMENT

Maintenance of native sod and revegetation of cultivated areas necessary to control erosion.—The friable consistency and soft, finely granular structure of these soils make them highly susceptible to blowing when not covered with native sod or other good plant cover. Their low productivity makes it difficult to produce crop stubbles adequate for erosion control. The most effective means of controlling erosion of these soils, therefore, is to maintain native sod on the areas that have not been cultivated and to retire cultivated areas to a permanent sod cover as rapidly as possible.

RANGE AND RANCH MANAGEMENT

**Best adapted for range.**—These shallow soils are unsuited to cultivation, and therefore small crop farming units are generally financially unstable. Large ranch units are in a more favorable economic condition, but overstocking or drought or a combination of both results in a low carrying capacity.

**Reorganization of farm units and improved grazing practices necessary.**—Proper stock-water distribution, grazing management, and retirement of cultivated and abandoned lands are the factors entering into the ranch organization.

Proper distribution of watering places distributes grazing more evenly over the range. Stock-water ponds and springs have proved satisfactory as a means of obtaining proper distribution of watering places.

It is important that reorganization of ranches and the introduction of improved grazing practices be considered in order to gain more profitable economic units. In order to maintain adequate feed reserves, ranch units should include small areas of soils representative of other problem-area groups suited to the production of cultivated crops. Usually such soils are interspersed with this problem-area group in sufficient quantity for feed production.

WILDLIFE AND WOODLAND PROGRAM

**Windbreak and wildlife plantings beneficial.**—This problem-area group includes about 100,000 acres of natural forest in Douglas, Elbert, and El Paso Counties, Colo., and occupies soils that must be maintained in forest cover for adequate protection against water erosion. Woodland management, stand improvement, reforestation, and protection from grazing and fire are essential. Wildlife values should be recognized and protected in developing management plans. In some cases grazing-resistant shrubs may be planted. Windbreaks for the protection of lifestock should be planted where needed. Many wildlife plantings in gullies may require fencing to exclude livestock.

Retirement of cultivated land to permanent vegetation, pasture improvement, protective plantings of shrubs around stock ponds, and proper management of the forested areas are the major treatments recognized as good wildlife-management practices.

## PROBLEM-AREA GROUP NO. 7—LOOSE SANDS AND SAND-HILL AREAS

[Approximately 8,530,000 acres]

### DESCRIPTION OF PHYSICAL FACTORS

SOILS

**Loose sands.**—Problem-area group No. 7 includes all the loose sand and sand-hill areas in the region. These are primarily grazing or wasteland areas. Infiltration is rapid, but moisture-holding capacity is low. There is very little surface-water movement even during very heavy rains.

Owing to their type of development, these soils may occur within any of the great soil groups in the region. They are derived in most cases from aeolian deposits and consist of deep loose sands having

little or no structural development. These soils are not suited for the production of cultivated crops. Only a relatively small percentage of the acreage in this problem-area group has been cultivated, and such cultivation has been largely confined to areas that occur in the same field with deeper and more productive soils and to areas that have relatively smooth relief similar to the better developed soils. By careful grazing management the grassland parts of these sandy areas may be used profitably for grazing and at the same time a high degree of erosion control can be maintained.

#### PHYSIOGRAPHY

**Undulating to dunelike relief.**—Loose sands and sand-hill areas occur principally as relatively small areas scattered rather widely over the entire region except in the mountainous areas in Colorado. They are derived from Quaternary and recent aeolian or water-laid deposits. The relief is predominantly undulating to dunelike, but in a few locations it is relatively smooth. Since the infiltration rate is very rapid, well-developed drainage systems are not common. In some cases loose sands occupy either or both sides of streams that have their origin in an area of heavier soils, and the small amount of water that is lost by surface run-off goes into these streams.

#### ERODIBILITY

**Erodes rapidly without adequate cover.**—An appreciable amount of erosion is always occurring on some of these soils, and well-stabilized areas may become subject to very severe damage by wind erosion when the natural cover is destroyed by plowing or by overgrazing.

### RECOMMENDED CONSERVATION PRACTICES

#### LAND RETIREMENT

**Stabilization needed.**—Stabilization by planting of adapted sorghum varieties and retirement to grass is needed on all areas. Since stabilization is difficult, great care must be taken to maintain a plant cover. Several plantings may be needed before an area becomes stabilized.

#### GRAZING AND RANGE MANAGEMENT

**Careful grazing management essential.**—Areas in this group should be utilized almost entirely for grazing, and very careful range management should be practiced to insure a continuous plant cover. Cultivated or idle areas should be restored to permanent vegetation. Where there is overconcentration of livestock in certain areas, due to improper salting methods and inadequate water supplies, the resultant trampling will cause blow-outs, which severely damage the ranges.

#### WATER CONSERVATION

**Mechanical structures not practical.**—Structures for moisture conservation are not practical, since very little run-off occurs and since the destruction of the normal plant cover incident to building these structures exposes an area to wind erosion.

RANCH MANAGEMENT

**Relatively large ranch units most profitable.**—Operating units in these areas can more nearly be described as ranch units, since they include very little cropland. A large acreage of grazing land is necessary to insure a profitable economic unit. To supplement range forage for livestock and insure an adequate feed reserve, however, a sufficient acreage of cropland belonging to other problem-area groups should be utilized for the production of feed crops.

**Grazing control and distribution of stock water essential.**—In addition to the establishment of feed reserves, maintenance of grazing control and adequate distribution of water and salting places on the range should be considered in ranch management.

WILDLIFE AND WOODLAND PROGRAM

**Windbreak plantings valuable.**—Carefully designed windbreaks for the protection of livestock should be regarded as a regular part of the ranch program. Only drought-resistant species are suitable since run-off water is not available. The plantings should not be clean cultivated because this would make the soil susceptible to blowing. Retiring land to native vegetation will encourage species of vegetation valuable for wildlife. Native shrubs should not be destroyed to encourage grass if this would be likely to cause soil blowing.

## PROBLEM-AREA GROUP NO. 8—VERY HEAVY CLAY SOILS SUITABLE ONLY FOR GRAZING

[Approximately 1,970,000 acres]

### DESCRIPTION OF PHYSICAL FACTORS

SOILS

**Very heavy clay soils on shale.**—In problem-area group No. 8 are included the very heavy textured highly dispersible soils. Moisture infiltration in these soils is very slow, and the rapid run-off is a possible source of floods. The highly dispersible nature of the soils makes both moisture conservation and erosion control more difficult than on other problem-area groups.

These soils are in the brown and dark-brown soil belts. They are developed on shales, usually of high salt content, and are very highly dispersed. Owing to this highly dispersed condition it is necessary to maintain a continuous cover to control erosion. The principal soil series is Pierre.

PHYSIOGRAPHY

**Smooth to rolling relief.**—These soils are limited to a few areas in eastern Colorado where shales, conducive to the development of highly dispersible soils, occur. The Pierre shale is the principal geologic formation on which these soils are developed. Surface relief varies from smooth to strongly rolling. Rolling relief predominates over most of these areas.

ERODIBILITY

**Erodes rapidly by both wind and water.**—Both wind and water erosion progress rapidly when the soil does not have an adequate per-

manent cover. Severe damage, particularly gullying and severe sheet erosion, has occurred.

### RECOMMENDED CONSERVATION PRACTICES

#### LAND RETIREMENT

All cultivated lands should be retired to permanent vegetation as rapidly as possible.

#### RANGE MANAGEMENT

**Grazing management needed to maintain and improve carrying capacity.**—This problem-area group is almost entirely devoted to grazing. Carrying capacities are low because of poor soils and lack of a cover of the more desirable and palatable grasses. Controlled grazing as a means of restoring the vegetation on these denuded areas is probably the most effective and economical method of erosion control. A larger amount of cover should be left on these soils than on the better soils of other problem-area groups. A definite system of deferred and rotated grazing should always be used, in which particular attention is given to the maximum production of seed and the natural reproduction of the grass species.

#### WATER CONSERVATION

**Discretion required in use of mechanical structures.**—Great care must be used in placing mechanical structures on these soils. Systems of contour furrows and ridges may be used on selected areas. High run-off occurs, which usually contributes to the formation of gullies and may severely damage the land. The most effective control measures for these gullies include the use of diversion ditches and contour ridges, which prevent most of the run-off water from entering the gullies. Small dams and springs for stock water have proved effective in the distribution of grazing. Great care should be taken in the selection of materials for dam construction.

#### RANCH MANAGEMENT

**Reorganization and retirement of cultivated land essential.**—Depletion of ranges by overstocking and the loss of soil on cultivated land have resulted in smaller returns for farm and ranch units. The maintenance of the range forage in sufficient amount to carry enough livestock to insure self-supporting ranch units is a serious problem. Many small farm units will have to be combined or added to larger properties in order to provide ranches that can be profitably operated. All cultivated land must be retired to native vegetation in order to control soil erosion. Grazing control is needed to build up the carrying capacity of range land and to provide a greater financial return.

In order to maintain adequate feed reserves, ranch units should include small areas of soils of other problem-area groups suited to the production of cultivated crops. Usually such soils are interspersed with this problem-area group in sufficient quantity for feed production.

#### WILDLIFE AND WOODLAND PROGRAM

**Gully and stock-water pond plantings desirable.**—The establishment of shrubs and vines as a means of reclaiming gullies, plantings

to protect stock-water ponds, and the retirement of all areas to permanent vegetation are wildlife-management practices recognized as applicable.

## PROBLEM-AREA GROUP NO. 9—ROUGH, BROKEN, AND STONY LAND

[Approximately 9,280,000 acres]

### DESCRIPTION OF PHYSICAL FACTORS

#### SOILS

**Stony soils, rock outcrops, and rough, broken lands.**—In problem-area group No. 9 are included all of the stony soils, rock outcrops, and rough, broken lands in the region except those in the mountainous areas. Foothills having a scattering growth of shrubs utilized primarily for grazing are included. The poorly developed soil material includes the various textural grades. Steep slopes over most of the area are conducive to considerable surface run-off, and this problem-area group is therefore a major source of floodwater.

#### PHYSIOGRAPHY

**Principally steep canyons, foothills, and rough, broken areas.**—Although this problem-area group consists principally of steep canyons, foothills, and other rough, broken areas, it also includes areas having nearly smooth to undulating relief that are stony and have very little soil development. A wide range of geologic formations is included. All the areas in this group have well-developed stream drainage.

#### ERODIBILITY

**Erodes rapidly by water.**—A relatively large amount of normal erosion constantly occurs. Accelerated water erosion has been aggravated on most areas by overgrazing. The control of wind erosion is a minor problem.

### RECOMMENDED CONSERVATION PRACTICES

#### RANGE MANAGEMENT

**Proper grazing management important.**—These lands are suited agriculturally only for grazing, and the principal means of controlling erosion is a system of carefully planned grazing management. Restoration of native vegetation can be best accomplished by grazing control and the adoption of accepted range-management practices such as rotated and deferred grazing. An ample plant cover is essential in the control of water erosion, and for this reason a strict balance should be maintained between the livestock units and the range forage.

#### WATER CONSERVATION

**Flood-source area.**—Land in this problem-area group contributes floodwaters to more valuable land, and flood-control structures are needed in certain areas. The topography and soils are such that water-conservation structures such as contour furrows, contour ridges, and terraces are in general not applicable.

**Water diversion important.**—Because of the stony nature of the soil and the rock outcrops on a large part of this problem-area group

diversion structures are needed in order to divert water to other areas where it can be controlled and utilized most effectively. Stock-water ponds and springs also have an important place in the distribution of grazing. Many small earth dams and diversion systems can be justified also as gully-control and flood-control structures. In some areas it has been found desirable to place temporary check dams in gullies, after run-off water from contributing areas has been controlled or diverted, to assist in establishing vegetation in these gullies.

#### RANCH MANAGEMENT

**Livestock production most important enterprise.**—The economy of this problem-area group is centered in livestock production. It is characterized by both large livestock operations and smaller uneconomic units. Because of overstocking or drought or both the carrying capacity on parts of these grazing lands has been greatly reduced.

**Reorganization and proper management of ranch lands essential.**—Grazing management, ranch organization, and unit reorganization are the controlling factors in the development of well-organized economic units.

Planning for ranch organization and operation must take into account all the known principles of livestock management and handling of range lands to secure profitable and sustained economic returns. Every effort in planning should be directed toward adjustments that give units of sufficient size to secure stable well-organized ranch set-ups.

#### WILDLIFE AND WOODLAND PROGRAM

**Great wildlife possibilities.**—With proper regulation, the wildlife possibilities are greater than in any other problem-area group except group No. 10. The greater part of the areas in this group should be managed so as to encourage wildlife. One of the main deficiencies is winter range for big game, such as deer and elk, that use the higher mountain area for summer range. Areas in this problem-area group can be utilized for this purpose and so far as is practical should be so used. Under private ownership, limited grazing can be practiced without detriment to wildlife. Management that preserves a healthy condition of the woodland cover is essential and must give primary importance to both woodland and wildlife values. Areas that naturally support a woodland cover and that have been denuded by grazing, fire, or other means should be revegetated. Gullies should be planted to woody species. Flood-control structures should be protected from silting by block plantings of mat-forming shrubs and vines.

### PROBLEM-AREA GROUP NO. 10—MOUNTAINOUS AREAS

[Approximately 6,880,000 acres]

#### DESCRIPTION OF PHYSICAL FACTORS

#### SOILS

**Principally shallow, stony, or gravelly.**—Problem-area group No. 10 includes all the forested mountains and hills in the region, where woodland management is a major problem. There is considerable variation in soils, but they are principally shallow, stony, or gravelly.

Slopes over most of the area are excessive, and the consequent rapid run-off makes this a flood-source area.

PHYSIOGRAPHY

**Mountainous.**—This problem-area group occupies that part of the Rocky Mountain range that extends across the western edge of the region through Colorado and into northern New Mexico. The geologic formations are numerous and varied. The relief varies, but in the main is rough and mountainous.

ERODIBILITY

**Erodes rapidly when vegetation is destroyed.**—Normal erosion is common, and accelerated water erosion is serious where forests have been burned or where serious overgrazing has occurred.

## RECOMMENDED CONSERVATION PRACTICES

RANCH AND WOODLAND MANAGEMENT

**Unit reorganization, woodland, and grazing management needed.**—Lands in private ownership in this flood-source area are mainly ranching enterprises with or without grazing privileges in national forests. The headquarters of these ranches are generally located in other problem-area groups. Lands are used for summer grazing.

In planning individual units, thought must be given to size and type of unit, with a view to the possible reorganization and elimination of the small uneconomic unit. These summer ranges should be grazed so that there is always adequate cover left at the end of the grazing season. Consideration should be given to the type of livestock most adaptable to the grazing conditions.

Consideration must be given to the fact that timberland has been seriously overcut for commercial products, with little regard to the remaining stand and the production of sustained yields. In the future timber should be cut so as to maintain sustained yields, and cut-over timberland suitable for reforestation should be replanted.

WATER CONSERVATION

**Reservoirs needed.**—These mountainous areas are generally too rocky for contour furrowing. They are the most important source of irrigation waters, and also the source of floodwaters that do considerable damage to some of the more valuable agricultural lands of other problem-area groups. The applicable water-conservation structures include small dams for stock water or flood control. Reservoirs are needed in strategic locations for flood control and storage of irrigation water.

GRAZING MANAGEMENT

**Careful grazing management essential to erosion control.**—Grazing-management practices that maintain the best possible cover on these lands are the principal means of controlling erosion.

WILDLIFE AND WOODLAND PROGRAM

**Wildlife and woodland program of major importance.**—This problem-area group includes approximately 4 million acres of national forests, which should be extended to include adjacent watershed areas

suitable for national forest purposes where the commercial value of the land is so low as to make conservation under private ownership impractical.

## IRRIGATED AREAS

[Approximately 2,500,000 acres]

### DESCRIPTION OF PHYSICAL FACTORS

#### SOILS

**Vary widely.**—Since irrigated areas occupy parts of several problem-area groups, there is a wide variation in these areas. The soils differ in depth, texture, moisture-infiltration rate, and rate of surface-water movement. But the use of irrigation water on these areas makes it necessary to use on them soil conservation measures that differ from those employed on the nonirrigated areas in the same problem-area groups.

#### PHYSIOGRAPHY

**Smooth relief.**—Most of the irrigated lands in the region are on relatively smooth relief, owing to the fact that such areas are usually selected for irrigation. Areas of more broken relief present difficult engineering problems in the distribution of water.

#### ERODIBILITY

**Only slight wind erosion.**—In general, erosion on irrigated lands is less acute than on nonirrigated areas. This is due to the natural protection provided by the more abundant plant residues that are produced on the irrigated areas. Sheet and gully erosion, however, have been induced by improper application of irrigation water.

### RECOMMENDED CONSERVATION PRACTICES

#### CROP MANAGEMENT

**Rotations important.**—Diversification, planned rotation, and intensive farming operations are practiced on most of the irrigated areas. Some of the adapted crops are sugar beets, potatoes, cantaloups, small grains, alfalfa, corn, the sorghums, beans, onions, and cabbage.

The fertility, drainage, and alkali conditions are the most important factors to be considered in farming these areas.

The systematic rotation of crops, in which legumes, fertilizers, and barnyard manures are used, is necessary in the maintenance of the fertility of these soils.

Because water is supplied by irrigation, crop production is not hazardous and lack of rainfall cannot cause crop failures. The crop stubbles, residues, and plant debris always present on the land reduce soil erosion.

#### WATER CONSERVATION

**Proper construction of irrigation lateral ditches important.**—Because of the relatively flat slopes of the irrigated lands little effort is made to conserve the small amount of run-off originating from rainfall. The field lateral ditches and bordered areas, however, retain most of this water. Serious erosion occurs in the main lateral ditches because the ditches have been constructed on improper grades. Sheet erosion on the steeper slopes and drainage conditions in the lower, flat areas

must be given consideration in planning irrigation systems. Relocation of the smaller ditches and the construction of permanent check dams in the larger ones so as to stabilize their grade have been effective in controlling this erosion.

### FARM MANAGEMENT

**Specialized agriculture.**—Despite extreme variation of market prices for specialized crops and finished livestock, these areas represent the most stable agriculture in the region. High land valuations and large investments in irrigation enterprises necessitate production of specialized crops and specialized livestock-feeding operations in order to utilize the waste and byproducts of these crops and to provide animal fertilizer necessary for the maintenance of soil fertility. The burden of taxation and mortgage indebtedness is relatively high.

Because of a higher degree of control of production factors in these areas, a selection of enterprises makes systems of balanced farming feasible. Farm planning must take into account available irrigation water in relation to crops produced, and such plans must be designed to obtain the best economic use of such water and at the same time prevent soil loss. There is a definite need for intelligent farm planning in these areas, directed specifically toward improvement of soil fertility, control of soil losses, and maximum utilization of available irrigation water.

### WILDLIFE AND WOODLAND PROGRAM

**Border plantings furnish wildlife protection.**—A large part of the irrigated land, particularly in the northern part of the region, is adapted to the propagation of ring-necked pheasants. The protection of irrigation mains by woody or herbaceous vegetation is therefore desirable. Shrubs, vines, and sweetclover are recommended where a protection of vegetation is desired. The planting of feed plots of small grains in odd corners of cultivated fields or as borders around the fields is recommended. Unharvested narrow strips of corn or other grain are particularly desirable.

The use of shallow-rooted trees such as cottonwoods and willows should be avoided on irrigated land because of the tendency of such species to sap available moisture from cropland. Deep-rooted evergreens, such as the ponderosa pine, give more protection at a smaller cost in moisture consumed. Protection against wind erosion is not so important as on the nonirrigated lands in the same problem-area groups. Conservation of moisture is important and can be materially increased by windbreak plantings.

## APPENDIX

Table 1 shows the acreage, distribution, present use, the principal physical factors, and the degree of erosion in each problem-area group. Table 2 shows the recommended land use adjustments and water-conservation measures in each State for all problem-area groups.

TABLE 1.—*Important features of soil conservation problem-area groups in Region 6*

| Problem-area group | Total area | Percentage of region | Present utilization | | | | |
|---|---|---|---|---|---|---|---|
| | | | Cultivated land | | | Pasture or grazing land | |
| | | | Area | Percentage of total area | Principal crops | Area | Principal plant species |
| | *Acres* | *Percent* | *Acres* | *Percent* | | *Acres* | |
| 1—Alluvial soils | 1,170,000 | 1.2 | 444,900 | 38 | Small grains, alfalfa, corn, and sorghums. | 725,100 | Western wheatgrass, saltgrass, grama, and shrubs. |
| 2—Deep, moderately heavy cropland | 16,620,000 | 17.2 | 12,182,000 | 73 | Wheat, corn, barley, cotton, and sorghums. | 4,438,000 | Buffalo, grama, and western wheatgrass. |
| 3—Deep, moderately sandy diversified cropland | 3,720,000 | 3.8 | 2,460,650 | 66 | Cotton, sorghums, corn, and wheat. | 1,259,350 | Buffalo, grama, and bunch grasses. |
| 4—Grazing and feed-crop area; soils of medium depth | 11,000,000 | 11.4 | 5,039,000 | 46 | Feed crops, grain sorghums, wheat, and broomcorn. | 5,961,000 | Western wheatgrass, grama, and buffalo grasses. |
| 5—Deep, sandy row-crop land | 12,230,000 | 12.6 | 5,832,100 | 48 | Corn, beans, cotton, and feed and grain sorghums. | 6,397,900 | Grama, bunch grasses, yucca sage and shin oak. |
| 6—Shallow grazing land | 23,000,000 | 23.7 | 3,368,700 | 15 | Not adapted to cultivation | 19,631,300 | Buffalo and grama grasses and shrubs. |
| 7—Loose sands and sand-hill areas | 8,530,000 | 8.8 | 424,150 | 5 | Unsuitable for cultivation | 8,105,850 | Bunch grasses, sage, and shin oak. |
| 8—Very heavy clay soils suitable only for grazing | 1,970,000 | 2.0 | 98,500 | 5 | do | 1,871,500 | Grama, western wheatgrass, and saltgrasses. |
| 9—Rough, broken, and stony land | 9,280,000 | 9.6 | | | do | 9,280,000 | Mixed grasses, shrubs, timber. |
| 10—Mountainous areas | 6,880,000 | 7.1 | | | do | 6,880,000 | Forest, brush, and mixed grasses. |
| Irrigated areas | 2,500,000 | 2.6 | 2,271,000 | 91 | Alfalfa, sugar beets, corn, wheat, barley, and specialized crops. | 229,000 | Grama, buffalo, saltgrass, and western wheatgrass. |
| | 96,900,000 | 100.0 | 32,121,000 | | | 64,779,000 | |

| Problem-area group | Relief | Climate | | | | Soils | | |
|---|---|---|---|---|---|---|---|---|
| | | Range of average annual rainfall | Range of average seasonal rainfall | Range of mean annual temperature | Range of average frost-free period | Color range | Textural range | |
| | | | | | | | Surface soil | Subsoil |
| | | *Inches* | *Inches* | °*F.* | *Days* | | | |
| 1—Alluvial soils | Smooth | 10–25 | 8–20 | 46–62 | 90–215 | Variable | Loamy sands to clay loams. | Loams to clays. |
| 2—Deep, moderately heavy cropland | do | 17–21 | 14–17 | 48–61 | 155–215 | Dark brown to dark-reddish brown. | Loams to clay loams | Clays. |
| 3—Deep, moderately sandy diversified cropland. | do | 18–24 | 15–19 | 46–62 | 135–215 | Dark brown to reddish brown. | Loamy fine sands to fine sandy loams. | Sandy clays. |
| 4—Grazing and feed-crop area; soils of medium depth. | Smooth to rolling | 12–17 | 10–13 | 46–59 | 135–200 | Brown | Loams to clay loams | Clays. |
| 5—Deep, sandy row-cropland | Undulating to gently rolling. | 14–21 | 11–16 | 46–62 | 140–215 | Brown, reddish brown, light brown. | Loamy sands to sandy loams. | Sandy clays to sandy loams. |
| 6—Shallow grazing land | Smooth to rolling | 12–22 | 9–16 | 46–62 | 135–215 | Light brown to gray | Sandy loams to clays | Sandy clay to clays. |
| 7—Loose sands and sand-hill areas | Undulating to dunelike | 11–22 | 8–16 | 48–62 | 140–215 | Light brown | Sands and loamy sands | Sands and sandy loams |
| 8—Very heavy clay soils suitable only for grazing. | Smooth to rolling | 12–16 | 8–13 | 44–51 | 110–155 | Olive gray | Clays | Clays. |
| 9—Rough, broken, and stony land | Rough, broken | 12–22 | 8–16 | 48–62 | 110–215 | | | |
| 10—Mountainous areas | Mountainous | 15–33 | 10–23 | 32–50 | 16–140 | | | |
| Irrigated areas | Smooth | 10–20 | 8–16 | 46–62 | 90–215 | Variable | Variable | Variable. |

TABLE 1.—*Important features of soil conservation problem-area groups in Region 6*—Continued

| Problem-area group | Soils—Continued | | | Water relations | | | |
|---|---|---|---|---|---|---|---|
| | Approximate depth | | Principal soil series | Moisture-holding capacity | Rate of infiltration | Run-off | |
| | Surface soil | Subsoil | | | | Relative rate | Relative quantity |
| | *Inches* | *Inches* | | | | | |
| 1—Alluvial soils | | | Lincoln, Spur, Yahola, Laurel, Cass. | Moderate | Medium to rapid | Slow | Moderate. |
| 2—Deep, moderately heavy cropland. | 9 | 26 | Keith, Pullman, Richfield. | High | Medium to slow | do | Moderate to high. |
| 3—Deep, moderately sandy diversified cropland. | 10 | 25 | Amarillo, Springer, Miles, Abilene, Pratt. | Moderately high | Rapid to medium | do | Moderate to low. |
| 4—Grazing and feed-crop area; soils of medium depth. | 6 | 16 | Weld, Zita, Baca | Moderate | Medium to slow | Medium to rapid | Moderate to high. |
| 5—Deep, sandy row-crop land | 12 | 18 | Springer, Amarillo, Miles, Abilene. | Low to moderate | Rapid | Slow to medium | Low. |
| 6—Shallow grazing land | 3 | 8 | Potter, Canyon, Colby, Vernon, Penrose, Minnequa. | Moderate | Medium to slow | Rapid | High. |
| 7—Loose sands and sand-hill areas | 15 | | Valentine, Enterprise | Very low | Very rapid | Slow | Low. |
| 8—Very heavy clay soils suitable only for grazing. | 4 | 6 | Pierre | Moderate to high | Very slow | Rapid | High. |
| 9—Rough, broken, and stony land | | | | Low | Medium | do | Do. |
| 10—Mountainous areas | | | | do | do | Very rapid | Very high. |
| Irrigated areas | 7 | 20 | | Moderate | do | Slow | Low. |

| Problem-area group | Degree of erosion | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Wind [1] | | | | | | | | Water | |
| | Slight | | Moderate | | Severe | | Very severe | | Cultivated land | Range land |
| | Cultivated land | Range land | Cultivated land | Range land | Cultivated land | Range land | Cultivated land | Range land | | |
| | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* | | |
| 1—Alluvial soils | 70 | 80 | 25 | 15 | 5 | 5 | 0 | 0 | Slight | Slight. |
| 2—Deep, moderately heavy cropland | 40 | 75 | 45 | 20 | 10 | 5 | 5 | 0 | do | Do. |
| 3—Deep, moderately sandy diversified cropland. | 40 | 90 | 55 | 8 | 5 | 2 | 0 | 0 | do | Do. |
| 4—Grazing and feed-crop area; soils of medium depth. | 10 | 50 | 30 | 30 | 40 | 10 | 20 | 10 | Moderate | Do. |
| 5—Deep, sandy row-crop land | 10 | 80 | 50 | 10 | 30 | 5 | 10 | 5 | Slight to moderate | Do. |
| 6—Shallow grazing land | 5 | 70 | 35 | 20 | 40 | 5 | 20 | 5 | Moderate | Do. |
| 7—Loose sands and sand-hill areas | | 80 | | 10 | | 5 | | 5 | Slight | Do. |
| 8—Very heavy clay soils suitable only for grazing. | | 50 | | 25 | | 15 | | 10 | Very severe | Severe. |
| 9—Rough, broken, and stony land | | 80 | | 15 | | 5 | | 0 | | Moderate. |
| 10—Mountainous areas | | 95 | | 5 | | 0 | | 0 | | Do. |
| Irrigated areas | | | | | | | | | Slight | Slight. |

[1] The control of wind erosion is not a major problem on irrigated areas.

TABLE 2.—*Recommended land use and water-conservation treatment in the problem-area groups in Region 6*

COLORADO

| Problem-area group | Area | Percentage of area to be retired or cultivated | Recommended land use | | | Recommended water-conservation treatment [1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Land to be retired | Cultivated land | Pasture or grazing land [2] | Cultivated land [3] | | Pasture or grazing land and land to be retired | | |
| | | | | | | Contour farming and terraces | Contour farming | Contour furrows and/or ridges | Water-spreading structures | Treatment needed not determined |
| | *Acres* | *Percent* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* |
| 1—Alluvial soils | 500,000 | 50 | 0 | 250,000 | 250,000 | 250,000 | 0 | 250,000 | 0 | 0 |
| 2a—Deep, moderately heavy cropland: Wheat, corn, barley | 714,000 | 80 | 5,712 | 565,488 | 142,800 | 565,488 | 0 | 148,512 | 0 | |
| 2b—Deep, moderately heavy cropland: Wheat, sorghums | 67,000 | 80 | 538 | 53,262 | 13,200 | 53,262 | 0 | 13,738 | 0 | |
| 2c—Deep, moderately heavy cropland: Wheat, cotton, sorghums | 0 | | | | | | | | | |
| 3a—Deep, moderately sandy diversified cropland: Corn | 395,500 | 85 | 3,365 | 333,135 | 59,000 | 333,135 | 0 | 62,365 | 0 | |
| 3b—Deep, moderately sandy diversified cropland: Feed crops, some wheat | 0 | | | | | | | | | |
| 3c—Deep, moderately sandy diversified cropland: Cotton and sorghums, some wheat | 0 | | | | | | | | | |
| 3d—Deep, moderately sandy diversified cropland: Cotton and sorghums | 0 | | | | | | | | | |
| 4—Grazing and feed-crop area; soils of medium depth | 6,500,000 | 41 | 1,326,500 | 1,324,500 | 3,849,000 | 1,324,500 | 0 | 5,175,500 | 384,900 | |
| 5a—Deep sandy row-crop land: Corn, beans, and feed crops | 2,075,000 | 60 | 124,444 | 1,119,956 | 830,600 | 559,978 | 559,978 | 415,300 | | 124,444 |
| 5b—Deep sandy row-crop land: Feed-crop area | 725,000 | 60 | 43,560 | 392,040 | 289,400 | 156,816 | 235,224 | 217,050 | | 43,560 |
| 5c—Deep sandy row-crop land: Cotton and sorghums | 0 | | | | | | | | | |
| 5d—Deep sandy row-crop land: Cotton and sorghums | 0 | | | | | | | | | |
| 6—Shallow grazing land | 8,500,000 | 25 | 1,912,500 | 212,500 | 6,375,000 | 212,500 | 0 | 6,693,750 | 1,275,000 | |
| 7—Loose sands and sand-hill areas | 2,167,000 | 8 | 147,050 | 25,950 | 1,994,000 | 0 | 0 | 0 | 0 | 0 |
| 8—Very heavy clay soils suitable only for grazing | 1,970,000 | 5 | 98,500 | 0 | 1,871,500 | | | 1,590,775 | | 98,500 |
| 9—Rough, broken, and stony land | 5,100,000 | 0 | 0 | 0 | 5,100,000 | | | 510,000 | 1,785,000 | |
| 10—Mountainous areas | 6,755,000 | 0 | 0 | 0 | 6,755,000 | | | | | [4] 6,755,000 |
| Irrigated areas | 2,290,000 | 90 | 0 | 2,061,000 | 229,000 | | | 0 | 229,000 | 0 |
| Total | 37,758,500 | | 3,662,169 | 6,337,831 | 27,758,500 | 3,455,679 | 795,202 | 15,076,990 | 3,673,900 | 7,021,504 |

| Problem-area group | Area | Percentage of area to be retired or cultivated | Recommended land use | | | Recommended water-conservation treatment [1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Land to be retired | Cultivated land | Pasture or grazing land [2] | Cultivated land [3] | | Pasture or grazing land and land to be retired | | |
| | | | | | | Contour farming and terraces | Contour farming | Contour furrows and/or ridges | Water-spreading structures | Treatment needed not determined |
| | *Acres* | *Percent* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* |
| 1—Alluvial soils | 335,000 | 50 | 0 | 167,500 | 167,500 | 167,500 | 0 | 167,500 | 0 | 0 |
| 2a—Deep, moderately heavy cropland: Wheat, corn, barley | 4,396,000 | 95 | 13,262 | 1,312,938 | 69,800 | 1,312,938 | 0 | 83,062 | 0 | 0 |
| 2b—Deep, moderately heavy cropland: Wheat, sorghums | 4,104,000 | 94 | 38,380 | 3,799,720 | 265,900 | 3,799,720 | 0 | 304,280 | 0 | 0 |
| 2c—Deep, moderately heavy cropland: Wheat, cotton, sorghums | 0 | | | | | | | | | |
| 3a—Deep, moderately sandy diversified cropland: Corn | 0 | | | | | | | | | |
| 3b—Deep, moderately sandy diversified cropland: Feed crops, some wheat | 177,000 | 90 | 1,583 | 156,717 | 18,700 | 156,717 | 0 | 20,283 | 0 | 0 |
| 3c—Deep, moderately sandy diversified cropland: Cotton and sorghums, some wheat | 0 | | | | | | | | | |
| 3d—Deep, moderately sandy diversified cropland: Cotton and sorghums | 0 | | | | | | | | | |
| 4—Grazing and feed-crop area; soils of medium depth | 3,300,000 | 65 | 858,000 | 1,287,000 | 1,155,000 | 1,287,000 | 0 | 2,013,000 | 128,700 | 0 |
| 5a—Deep sandy row-crop land: Corn, beans, and feed-crops | 0 | | | | | | | | | |
| 5b—Deep sandy row-crop land: Feed-crop area | 1,320,000 | 65 | 85,800 | 772,200 | 462,000 | 308,880 | 463,320 | 346,500 | | 85,800 |
| 5c—Deep sandy row-crop land: Cotton and sorghums | 0 | | | | | | | | | |
| 5d—Deep sandy row-crop land: Cotton and sorghums | 0 | | | | | | | | | |
| 6—Shallow grazing land | 2,400,000 | 20 | 432,000 | 48,000 | 1,920,000 | 48,000 | 0 | 1,872,000 | 384,000 | 0 |
| 7—Loose sands and sand-hill areas | 836,000 | 8 | 56,865 | 10,035 | 769,100 | | | 0 | 0 | 0 |
| 8—Very heavy clay soils suitable only for grazing | 0 | | | | | | | | | |
| 9—Rough, broken, and stony land | 89,000 | 0 | 0 | 0 | 89,000 | | | 8,900 | 31,150 | |
| 10—Mountainous areas | 0 | | | | | | | | | |
| Irrigated areas | 160,000 | 100 | 0 | 160,000 | 0 | | | | | |
| Total | 14,117,000 | | 1,485,890 | 7,714,110 | 4,917,000 | 7,080,755 | 463,320 | 4,815,525 | 543,850 | 85,800 |

[1] Since not all the area needs water-conservation treatment and since both water-spreading structures and contour furrows or ridges may be recommended for the same area, the acreages shown for any 1 problem-area group are not necessarily equal to the total acreage in that group.

[2] Includes all land other than cultivated land and land to be retired. All the land recommended for pasture or grazing in problem-area groups Nos. 2 and 3 and a part of that in problem-area group No. 6 is tillable.

[3] The treatment needed on the irrigated areas has not been determined.

[4] Water-conservation possibilities are already largely utilized.

[5] The treatment needed on irrigated areas and on cultivated land in problem-area group No. 7 has not been determined.

[6] The treatment needed on cultivated land in problem-area group No. 7 has not been determined.

TABLE 2.—*Recommended land use and water-conservation treatment in the problem-area groups in Region 6*—Continued

NEW MEXICO

| Problem-area group | Area | Percentage of area to be retired or cultivated | Recommended land use | | | Recommended water-conservation treatment [1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Land to be retired | Cultivated land | Pasture or grazing land [2] | Cultivated land [5] | | Pasture or grazing land and land to be retired | | |
| | | | | | | Contour farming and terraces | Contour farming | Contour furrows and/or ridges | Water-spreading structures | Treatment needed not determined |
| | *Acres* | *Percent* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* |
| 1—Alluvial soils | 220,000 | 10 | 0 | 22,000 | 198,000 | 22,000 | 0 | 198,000 | | |
| 2a—Deep, moderately heavy cropland: Wheat, corn, barley | 0 | | | | | | | | | |
| 2b—Deep, moderately heavy cropland: Wheat, sorghums | 1,170,000 | 35 | 4,096 | 405,404 | 760,500 | 405,404 | 0 | 764,596 | 0 | 0 |
| 2c—Deep, moderately heavy cropland: Wheat, cotton, sorghums | 92,000 | 35 | 322 | 31,878 | 59,800 | 31,878 | 0 | 60,122 | 0 | 0 |
| 3a—Deep, moderately sandy diversified cropland: Corn | 0 | | | | | | | | | |
| 3b—Deep, moderately sandy diversified cropland: Feed crops, some wheat | 122,800 | 40 | 491 | 48,609 | 73,700 | 48,609 | 0 | 74,191 | 0 | 0 |
| 3c—Deep, moderately sandy diversified cropland: Cotton and sorghums, some wheat | 122,800 | 40 | 491 | 48,609 | 73,700 | 48,609 | 0 | 74,191 | 0 | 0 |
| 3d—Deep, moderately sandy diversified cropland: Cotton and sorghums | 0 | | | | | | | | | |
| 4—Grazing and feed-crop area; soils of medium depth | 700,000 | 20 | 70,000 | 70,000 | 560,000 | 70,000 | 0 | 630,000 | 56,000 | 0 |
| 5a—Deep sandy row-crop land: Corn, beans, and feed crops | 54,500 | 25 | 1,350 | 12,150 | 41,000 | 6,075 | 6,075 | 20,500 | | 1,350 |
| 5b—Deep sandy row-crop land: Feed-crop area | 1,180,500 | 25 | 29,500 | 265,500 | 885,500 | 106,200 | 159,300 | 664,125 | | 29,500 |
| 5c—Deep sandy row-crop land: Cotton and sorghums | 1,065,000 | 20 | 21,460 | 193,140 | 850,400 | 96,570 | 96,570 | 425,200 | | 21,460 |
| 5d—Deep sandy row-crop land: Cotton and sorghums | 0 | | | | | | | | | |
| 6—Shallow grazing land | 5,000,000 | 5 | 225,000 | 25,000 | 4,750,000 | 25,000 | 0 | 3,787,500 | 950,000 | 0 |
| 7—Loose sands and sand-hill areas | 2,301,500 | 1 | 19,550 | 3,450 | 2,278,500 | | | 0 | 0 | 0 |
| 8—Very heavy clay soils suitable only for grazing | 0 | | | | | | | | | |
| 9—Rough, broken, and stony land | 2,050,000 | 0 | 0 | 0 | 2,050,000 | | | 205,000 | 717,500 | |
| 10—Mountainous areas | 125,000 | 0 | 0 | 0 | 125,000 | | | | | [4] 125,000 |
| Irrigated areas | 50,000 | 100 | 0 | 50,000 | 0 | | | | | |
| Total | 14,254,100 | | 372,260 | 1,175,740 | 12,706,100 | 860,345 | 261,945 | 6,903,425 | 1,723,500 | 177,310 |

| Problem-area group | Area | Percentage of area to be retired or cultivated | Recommended land use | | | Recommended water-conservation treatment [1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Land to be retired | Cultivated land | Pasture or grazing land [2] | Cultivated land [6] | | Pasture or grazing land and land to be retired | | |
| | | | | | | Contour farming and terraces | Contour farming | Contour furrows and/or ridges | Water-spreading structures | Treatment needed not determined |
| | *Acres* | *Percent* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* |
| 1—Alluvial soils | 61,000 | 0 | 0 | 0 | 61,000 | | | 61,000 | 0 | 0 |
| 2a—Deep, moderately heavy cropland: Wheat, corn, barley | 0 | | | | | | | | | |
| 2b—Deep, moderately heavy cropland: Wheat, sorghums | 628,000 | 85 | 5,338 | 528,462 | 94,200 | 528,462 | 0 | 99,538 | 0 | 0 |
| 2c—Deep, moderately heavy cropland: Wheat, cotton, sorghums | 0 | | | | | | | | | |
| 3a—Deep, moderately sandy diversified cropland: Corn | 0 | | | | | | | | | |
| 3b—Deep, moderately sandy diversified cropland: Feed crops, some wheat | 405,300 | 85 | 3,445 | 341,055 | 60,800 | 341,055 | 0 | 64,245 | 0 | 0 |
| 3c—Deep, moderately sandy diversified cropland: Cotton and sorghums, some wheat | 0 | | | | | | | | | |
| 3d—Deep, moderately sandy diversified cropland: Cotton and sorghums | 0 | | | | | | | | | |
| 4—Grazing and feed-crop area; soils of medium depth | 10,000 | 50 | 2,500 | 2,500 | 5,000 | 2,500 | 0 | 7,500 | 500 | 0 |
| 5a—Deep sandy row-crop land: Corn, beans, and feed crops | 0 | | | | | | | | | |
| 5b—Deep sandy row-crop land: Feed-crop area | 1,280,000 | 60 | 76,800 | 691,200 | 512,000 | 276,480 | 414,720 | 384,000 | | 76,800 |
| 5c—Deep sandy row-crop land: Cotton and sorghums | 0 | | | | | | | | | |
| 5d—Deep sandy row-crop land: Cotton and sorghums | 0 | | | | | | | | | |
| 6—Shallow grazing land | 1,100,000 | 20 | 192,301 | 21,399 | 886,300 | 21,399 | 0 | 857,055 | 177,260 | 0 |
| 7—Loose sands and sand-hill areas | 160,500 | 5 | 6,800 | 1,200 | 152,500 | | | 0 | 0 | 0 |
| 8—Very heavy clay soils suitable only for grazing | 0 | | | | | | | | | |
| 9—Rough, broken, and stony land | 61,000 | 0 | 0 | 0 | 61,000 | | | 6,100 | 21,350 | 0 |
| 10—Mountainous areas | 0 | | | | | | | | | |
| Irrigated areas | 0 | | | | | | | | | |
| Total | 3,705,800 | | 287,184 | 1,585,816 | 1,832,800 | 1,169,896 | 414,720 | 1,479,438 | 199,110 | 76,800 |

See footnotes on p. 35.

TABLE 2.—*Recommended land use and water-conservation treatment in the problem-area groups in Region 6*—Continued

TEXAS

| Problem-area group | Area | Percentage of area to be retired or cultivated | Recommended land use | | | Recommended water-conservation treatment [1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Land to be retired | Cultivated land | Pasture or grazing land [2] | Cultivated land [6] | | Pasture or grazing land and land to be retired | | |
| | | | | | | Contour farming and terraces | Contour farming | Contour furrows and/or ridges | Water-spreading structures | Treatment needed not determined |
| | *Acres* | *Percent* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* |
| 1—Alluvial soils | 54,000 | 10 | 0 | 5,400 | 48,600 | 5,400 | 0 | 48,600 | 0 | 0 |
| 2a—Deep, moderately heavy cropland: Wheat, corn, barley | 0 | | | | | | | | | |
| 2b—Deep, moderately heavy cropland: Wheat, sorghums | 4,462,000 | 60 | 27,704 | 2,649,496 | 1,784,800 | 2,649,496 | 0 | 1,812,504 | 0 | 0 |
| 2c—Deep, moderately heavy cropland: Wheat, cotton, sorghums | 3,987,000 | 68 | 0 | 2,740,000 | 1,247,000 | 2,740,000 | 0 | 1,247,000 | 0 | 0 |
| 3a—Deep, moderately sandy diversified cropland: Corn | 0 | | | | | | | | | |
| 3b—Deep, moderately sandy diversified cropland: Feed crops, some wheat | 213,700 | 60 | 1,282 | 126,968 | 85,450 | 126,968 | 0 | 86,732 | 0 | 0 |
| 3c—Deep, moderately sandy diversified cropland: Cotton and sorghums, some wheat | 503,700 | 65 | 3,274 | 324,126 | 176,300 | 324,126 | 0 | 179,574 | 0 | 0 |
| 3d—Deep, moderately sandy diversified cropland: Cotton and sorghums | 1,779,200 | 60 | 10,675 | 1,056,825 | 711,700 | 1,056,825 | 0 | 722,375 | 0 | 0 |
| 4—Grazing and feed-crop area; soils of medium depth | 490,000 | 20 | 49,000 | 49,000 | 392,000 | 49,000 | 0 | 441,000 | 39,200 | 0 |
| 5a—Deep sandy row-crop land: Corn, beans, and feed crops | 0 | | | | | | | | | |
| 5b—Deep sandy row-crop land: Feed-crop area | 1,310,000 | 30 | 39,300 | 353,700 | 917,000 | 141,480 | 212,220 | 687,750 | | 39,300 |
| 5c—Deep sandy row-crop land: Cotton and sorghums | 2,010,000 | 50 | 100,500 | 904,500 | 1,005,000 | 361,800 | 542,700 | 753,750 | 100,500 | 100,500 |
| 5d—Deep sandy row-crop land: Cotton and sorghums | 1,210,000 | 50 | 60,500 | 544,500 | 605,000 | 544,500 | 0 | 453,750 | 121,000 | 60,500 |
| 6—Shallow grazing land | 6,000,000 | 5 | 270,000 | 30,000 | 5,700,000 | 30,000 | 0 | 4,545,000 | 1,140,000 | 0 |
| 7—Loose sands and sand-hill areas | 3,065,000 | 5 | 130,262 | 22,988 | 2,911,750 | | | 0 | 0 | 0 |
| 8—Very heavy clay soils suitable only for grazing | 0 | | | | | | | | | |
| 9—Rough, broken, and stony land | 1,980,000 | 0 | 0 | 0 | 1,980,000 | | | 198,000 | 693,000 | 0 |
| 10—Mountainous areas | 0 | | | | | | | | | |
| Irrigated areas | 0 | | | | | | | | | |
| Total | 27,064,600 | | 692,497 | 8,807,503 | 17,564,600 | 8,029,595 | 754,920 | 11,176,035 | 2,093,700 | 200,300 |

## ENTIRE REGION

| Problem-area group | Area | Percentage of area to be retired or cultivated | Recommended land use | | | Recommended water-conservation treatment [1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Land to be retired | Cultivated land | Pasture or grazing land [2] | Cultivated land | | Pasture or grazing land and land to be retired | | |
| | | | | | | Contour farming and terraces | Contour farming | Contour furrows and/or ridges | Water-spreading structures | Treatment needed not determined |
| | *Acres* | *Percent* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* | *Acres* |
| 1—Alluvial soils | 1, 170, 000 | 1. 2 | 0 | 444, 900 | 725, 100 | 444, 900 | 0 | 725, 100 | 0 | 0 |
| 2a—Deep, moderately heavy cropland: Wheat, corn, barley | 2, 110, 000 | 2. 2 | 18, 974 | 1, 878, 426 | 212, 600 | 1, 878, 426 | 0 | 231, 574 | 0 | 0 |
| 2b—Deep, moderately heavy cropland: Wheat, sorghums | 10, 431, 000 | 10. 8 | 76, 056 | 7, 436, 344 | 2, 918, 600 | 7, 436, 344 | 0 | 2, 994, 656 | 0 | 0 |
| 2c—Deep, moderately heavy cropland: Wheat, cotton, sorghums | 4, 079, 000 | 4. 2 | 322 | 2, 771, 878 | 1, 306, 800 | 2, 771, 878 | 0 | 1, 307, 122 | 0 | 0 |
| 3a—Deep, moderately sandy diversified cropland: Corn | 395, 500 | . 4 | 3, 365 | 333, 135 | 59, 000 | 333, 135 | 0 | 62, 365 | 0 | 0 |
| 3b—Deep, moderately sandy diversified cropland: Feed crops, some wheat | 918, 800 | . 9 | 6, 801 | 673, 349 | 238, 650 | 673, 349 | 0 | 245, 451 | 0 | 0 |
| 3c—Deep, moderately sandy diversified cropland: Cotton and sorghums, some wheat | 626, 500 | . 6 | 3, 765 | 372, 735 | 250, 000 | 372, 735 | 0 | 253, 765 | 0 | 0 |
| 3d—Deep, moderately sandy diversified cropland: Cotton and sorghums | 1, 779, 200 | 1. 8 | 10, 675 | 1, 056, 825 | 711, 700 | 1, 056, 825 | 0 | 722, 375 | 0 | 0 |
| 4—Grazing and feed-crop area; soils of medium depth | 11, 000, 000 | 11. 4 | 2, 306, 000 | 2, 733, 000 | 5, 961, 000 | 2, 733, 000 | 0 | 8, 267, 000 | 609, 300 | 0 |
| 5a—Deep sandy row-crop land: Corn, beans, and feed crops | 2, 129, 500 | 2. 2 | 125, 794 | 1, 132, 106 | 871, 600 | 566, 053 | 566, 053 | 435, 800 | ---------- | 125, 794 |
| 5b—Deep sandy row-crop land: Feed-crop area | 5, 815, 500 | 6. 0 | 274, 960 | 2, 474, 640 | 3, 065, 900 | 989, 856 | 1, 484, 784 | 2, 299, 425 | ---------- | 274, 960 |
| 5c—Deep sandy row-crop land: Cotton and sorghums | 3, 075, 000 | 3. 2 | 121, 960 | 1, 097, 640 | 1, 855, 400 | 458, 370 | 639, 270 | 1, 178, 950 | 100, 500 | 121, 960 |
| 5d—Deep sandy row-crop land: Cotton and sorghums | 1, 210, 000 | 1. 2 | 60, 500 | 544, 500 | 605, 000 | 544, 500 | 0 | 453, 750 | 121, 000 | 60, 500 |
| 6—Shallow grazing land | 23, 000, 000 | 23. 7 | 3, 031, 801 | 336, 899 | 19, 631, 300 | 336, 899 | 0 | 17, 755, 305 | 3, 926, 260 | 0 |
| 7—Loose sands and sand-hill areas | 8, 530, 000 | 8. 8 | 360, 527 | 63, 623 | 8, 105, 850 | ---------- | ---------- | 0 | 0 | 0 |
| 8—Very heavy clay soils suitable only for grazing | 1, 970, 000 | 2. 0 | 98, 500 | 0 | 1, 871, 500 | ---------- | ---------- | 1, 590, 775 | ---------- | 98, 500 |
| 9—Rough, broken, and stony land | 9, 280, 000 | 9. 6 | 0 | 0 | 9, 280, 000 | ---------- | ---------- | 928, 000 | 3, 248, 000 | 0 |
| 10—Mountainous areas | 6, 880, 000 | 7. 1 | 0 | 0 | 6, 880, 000 | ---------- | ---------- | ---------- | ---------- | [4] 6, 880, 000 |
| Irrigated areas | 2, 500, 000 | 2. 6 | 0 | 2, 271, 000 | 229, 000 | ---------- | ---------- | 0 | 229, 000 | 0 |
| Total | 96, 900, 000 | ---------- | 6, 500, 000 | 25, 621, 000 | 64, 779, 000 | 20, 596, 270 | 2, 690, 107 | 39, 451, 413 | 8, 234, 060 | 7, 561, 714 |

See footnotes on p. 35.

## SOURCES OF INFORMATION USED IN THE PREPARATION OF THE MAP OF PROBLEM-AREA GROUPS IN REGION 6

In the preparation of the accompanying map every available source of information has been used, both in preparation of the base map and in the delineation of the areas that compose the problem-area groups. The base map has been prepared from the standard Geological Survey and Coast and Geodetic survey maps. Aerial photographs also have been used in correcting and adding detail to the drainage systems.

In delineating area boundaries use has been made of all applicable reconnaissance and detailed soil surveys made by the Bureau of Chemistry and Soils and State agricultural experiment stations. Reconnaissance and detailed soil conservation surveys, as well as uncorrelated soil surveys made by the State agricultural experiment stations, the Bureau of Agricultural Economics, and other Federal agencies, have been used.

Published and unpublished data used in the preparation of the map include: Geological Survey maps of Colorado, Kansas, New Mexico, and Texas; the following soil surveys of the Bureau of Chemistry and Soils in cooperation with State agricultural experiment stations—Western Kansas, 1910; Texas County, Okla., 1930; Panhandle of Texas, 1910; Northwest Texas, 1919; West-Central Texas, 1922; Arkansas Valley Area, Colo., 1926; Brighton Area, Colo., 1932; Fort Collins Area, Colo., 1927; Greeley Area, Colo., 1929; Longmont Area, Colo., 1930; Washington County Area, Colo. (in progress); Lovington Area, N. Mex., 1932; Garden City Area, Kans., 1904; Lubbock County, Tex., 1917; Potter County, Tex., 1929; Randall County, Tex., 1930; Wheeler County, Tex., 1932; two unpublished soil surveys made by the Bureau of Agricultural Economics, one of Otero County, Colo., and one of Thomas County, Kans.; and the following conservation surveys showing soil, slope, erosion, and land use—a survey of the southern Great Plains wind-erosion area by the Soil Conservation Service in 1937, an unpublished survey of eastern New Mexico, unpublished detailed surveys covering 13 demonstration project areas, scattered farms placed under cooperative agreements in the 14 C. C. C. camp areas of Region 6, farms placed under cooperative agreements in the nine wind erosion conservation districts in Texas, and detailed surveys now in progress on the land-utilization projects.

Frequent reference has also been made to reports published by State agricultural experiment stations and other agencies. Contributions in the form of criticisms and suggestions have been made by F. A. Hayes and W. T. Carter, of the Bureau of Chemistry and Soils; Lindsey A. Brown and Alvin Kezer, Colorado Agricultural Experiment Station; R. I. Throckmorton and W. H. Metzger, Kansas State College of Agriculture; H. N. Watenpaugh, Bureau of Agricultural Economics; and H. J. Harper, Oklahoma Agricultural and Mechanical College.

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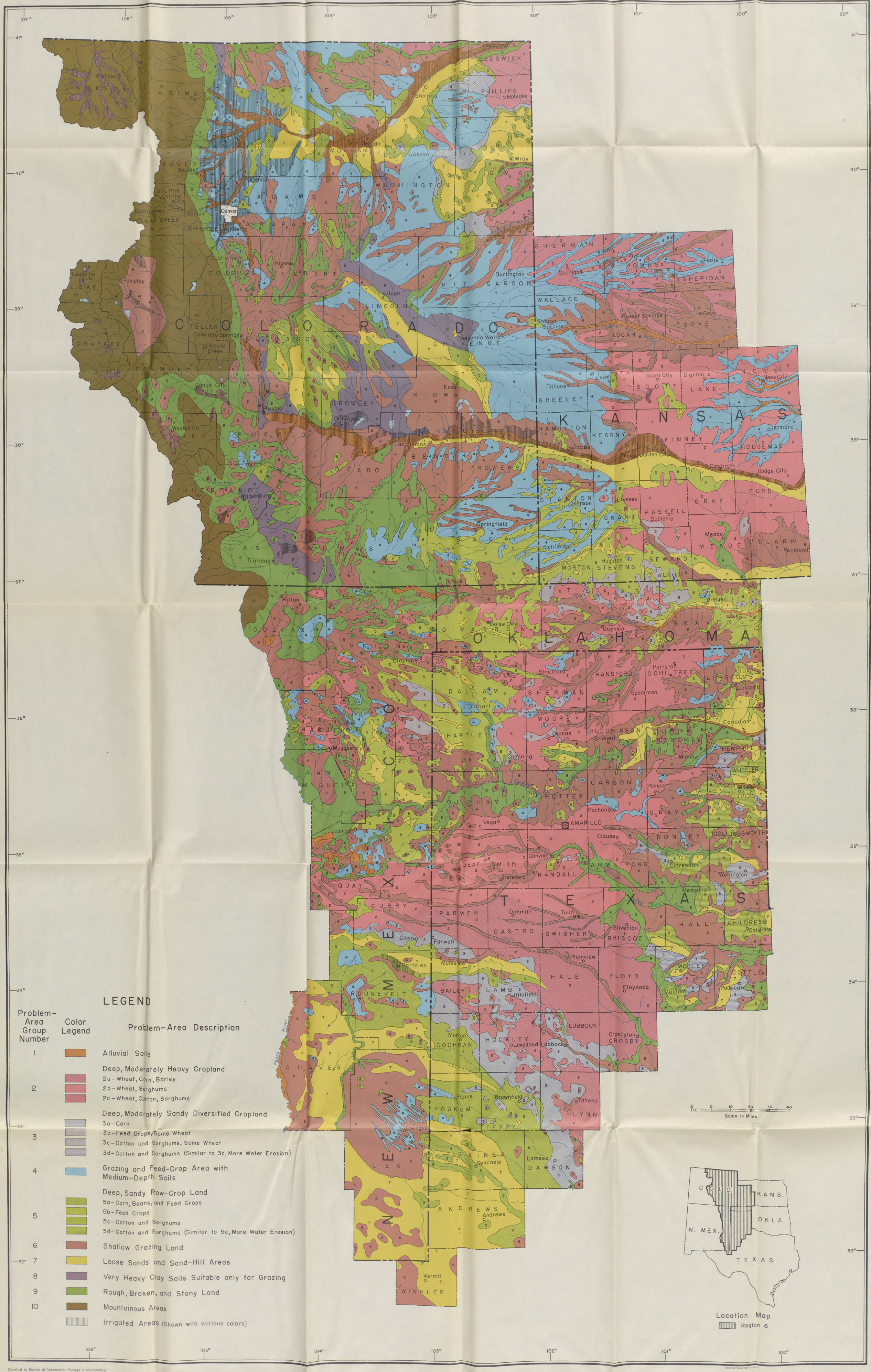
SOIL CONSERVATION SERVICE
H. H. BENNETT, CHIEF

# SOIL CONSERVATION PROBLEM-AREA GROUPS

## BASED ON PHYSICAL FACTORS

REGION 6

Comprised of portions of Colorado, Kansas, Texas, New Mexico, and Oklahoma.




## LEGEND

| Problem-Area Group Number | Color Legend | Problem-Area Description |
|---|---|---|
| 1 | | Alluvial Soils |
| 2 | | Deep, Moderately Heavy Cropland<br>2a – Wheat, Corn, Barley<br>2b – Wheat, Sorghums<br>2c – Wheat, Cotton, Sorghums |
| 3 | | Deep, Moderately Sandy Diversified Cropland<br>3a – Corn<br>3b – Feed Crops, Some Wheat<br>3c – Cotton and Sorghums, Some Wheat<br>3d – Cotton and Sorghums (Similar to 3c, More Water Erosion) |
| 4 | | Grazing and Feed-Crop Area with Medium-Depth Soils |
| 5 | | Deep, Sandy Row-Crop Land<br>5a – Corn, Beans, and Feed Crops<br>5b – Feed Crops<br>5c – Cotton and Sorghums<br>5d – Cotton and Sorghums (Similar to 5c, More Water Erosion) |
| 6 | | Shallow Grazing Land |
| 7 | | Loose Sands and Sand-Hill Areas |
| 8 | | Very Heavy Clay Soils Suitable only for Grazing |
| 9 | | Rough, Broken, and Stony Land |
| 10 | | Mountainous Areas |
| | | Irrigated Areas (Shown with various colors) |

Compiled by Section of Conservation Surveys in collaboration with other technical sections and project technicians under the direction of H. H. Finnell, Regional Conservator.

Based on all available information of the U. S. Department of Agriculture and the State Agricultural Experiment Stations.

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